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BALANCE

Much confusion and some hokum surround this subject. Confining itself strictly to static balance, this article constitutes a clear, concise, yet thorough resumé of the methods of obtaining and testing balance in mechanical bodies

CHESTER B. LORD
Associate Editor

WHEN Blondin crossed the Niagara Gorge on a tight rope it was considered such a wonderful feat of balancing that it is, or at least was for a long time, recorded in school histories. As a matter of fact, he merely shifted his center of gravity to a point below his hip joints by means of his long balance pole. He was in no danger of falling as long as his center of gravity was directly above the center of his base when he changed his weight for one foot to the other.

The balance pole was so long that when it was held as low as his extended arms permitted, its weighted ends drooped and hung to the level of the rope, perhaps even lower. Because of the length of the pole this drooping was not noticeable. The skill and daring was in walking a swaying rope above the gorge, not in balancing himself.

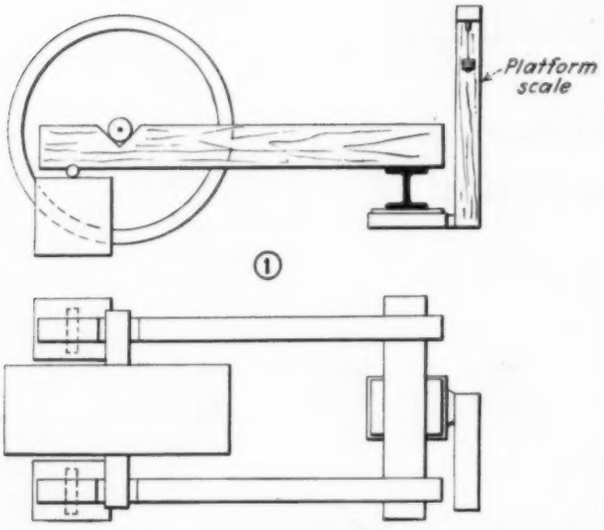
As Blondin's weight shifted from one foot to the other he maintained balance by shifting his weighted pole from one side to the other, like moving a weight back and forth on a steelyard scale. This same principle is employed on practically all static balancing machines now in use.

Mechanically speaking, when the forces acting on a body do not hold it in equilibrium the body is said to be unbalanced. If all the forces acting are gravitational reactions, the body is said to be statically unbalanced. If the forces throwing the body out of equilibrium are the result of the motion of the body, the body is dynamically out of balance.

There are thus two conditions of unbalance: one, where the unbalance may be corrected by adding a single weight in the same plane of rotation as the unbalance; the other where it is necessary to add weight in more than one place, and in different planes of rotation. The first of these two conditions, static unbalance, is represented by a disk or a flywheel. An equivalent weight placed at 180 deg. to the heavy part will place it in balance so that it will not vibrate when in motion. The second condition, dynamic unbalance, is represented by an eccentric drum with a length, or width, greater than its diameter. If a single compensating weight is used, the drum will be in a state of balance when at rest, but not when in motion. The same thing is true when only one end is heavy and the compensating weight is placed at the opposite end.

A flywheel, then, may always be balanced by a single compensating weight opposite the heavy part. A drum on the other hand, may either be in static unbalance, and may thus be balanced by a single weight—if the unbalance couple is at the center line of its gravity—or it may be in dynamic unbalance and require two or more weights at different places along its length. The speed at which a part runs affects the care with which it must be balanced—but we will ignore that fact for the present.

The static balancing of a rotating part is analogous to weighing a pound of butter or any other material. The known weight on one end of the beam must be balanced by added material on the other until the beam is in equilibrium. In the absence of straight edges or other apparatus a part may be balanced accurately with two pieces of wood and a weighing scale as shown in Fig. 1.



When the part being tested is rotated, any unbalanced weight will show on the scale as the heavy section moves toward or away from it. When the weight is greatest it is obvious that the heavy part is in a horizontal plane at its nearest point to the scale. By marking this point and turning the part through 180 deg. the least weight should be indicated. A weight one half the difference between the maximum and minimum weight shown on the scale, placed 180 deg. from the heavy side will place the part in static balance, having in mind the radius at which it is placed of course. This is the principle used in the more sensitive forms of static balancing machines.

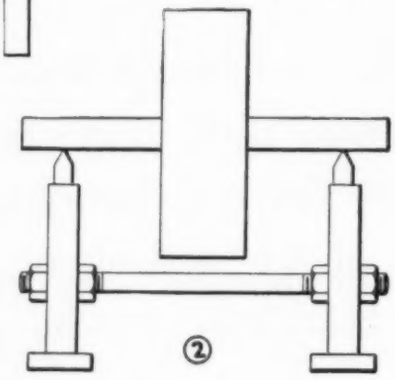
From the shop standpoint, the simplest method of static balancing is by means of balancing ways. In some cases these are narrow knife edges, Fig. 2, at others fairly wide ways slightly convex or perfectly flat. The danger of using flat ways for a heavy weight is that under such a load the ways are likely to tip inward, and the outer edge may thus mar the shaft. In other cases the shaft may sag from its load.

There are other objections to static balancing on level ways. First, as pointed out, the danger of marring the shaft of heavy parts; second, the fact that as the weight increases, the error due to roller friction increases; and third, heavy bodies cannot be supported satisfactorily on narrow ways.

One means of curing this latter condition is to make a set of hardened and ground rings, Fig. 3, wide enough to carry the weight of the part without marring and large enough to accommodate a limited range of shaft sizes. The hardened ring rests on the ways, with the shaft within the ring. The penalty for using rings, however, is an increase of rolling friction, probably in the vicinity of a hundred per cent or more, because we have added a concave-convex surface friction to the convex-flat surface friction.

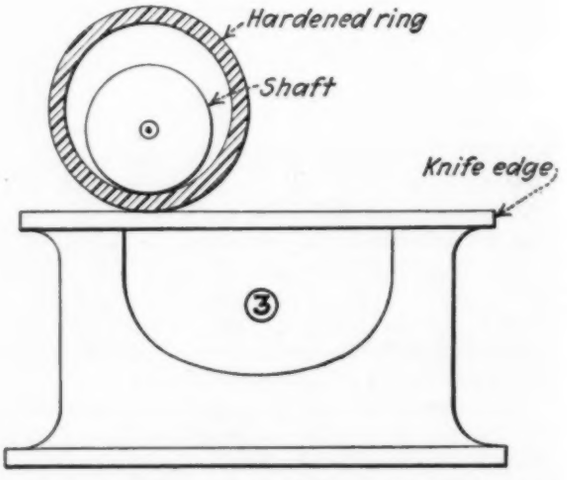
Surface or rolling friction causes a sluggishness that may be minimized by attaching a foundry flask vibrator to the frame of the balancing ways. The vibration tends to prevent the part being balanced from coming to rest. Of course, where the diameter of the part is very large in proportion to its shaft, sluggishness is barely perceptible under any circumstances.

The next step in balancing is the use of two disks with roller or ball bearings as in Figs. 4 and 5. The disks may be small and in the same plane of rotation, or they may be large and overlap each other as far as the hubs will allow. Where the two are in line, they must necessarily be of small diameter, because otherwise the center of gravity of the part to be balanced would be so low that the sensitivity of the apparatus would be affected and its movement be sluggish. As it is, the size of the bearings in relation to the size of the disk reduces sensitivity somewhat. To improve the above conditions, a disk balancer with large disks was designed. These disks overlap. The same limitations apply in this case in regard to sensitivity. The larger the disks the deeper the depression between them where the shaft of the part being balanced rests, and the greater the inertia of the disks. There finally comes a point where there is no advantage in two large disks.



The next step is one very large disk with a second and smaller one just far enough away from the vertical center line of the large disk to allow a fairly large shaft to rest upon the large one. The small disk in Fig. 6 acts only as a steadying medium.

Taken as a whole the roller disk type of static balance is quite satisfactory for balancing parts where the body is considerably larger than the shaft that rests upon the disks, and



where a single weight placed 180 deg. will put the part in balance.

At the beginning of the article, reference was made to the relation of weighing, and balancing. This principle is incorporated into most of the automatic types of static balancing machines. The principle is simple. Out of balance, as explained previously, is caused by an unequal distribution of weight. If the part to be balanced is hung or fixed at one end of a frame resting on knife edges and the opposite end of the frame is weighted to counter-balance the part to be tested, the frame will be in equilibrium and the part to be balanced will have its heavy part below the horizontal line. If, then, the part being balanced is revolved, its out of balance condition, as shown by a pointer or indicator on the scale, will change the angle of the swinging frame as the heavy point moves toward or recedes from the central knife edge. On the larger sizes of this type of balance, the shaft or mandrel

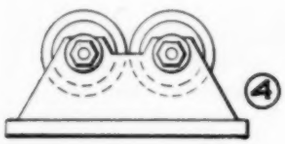
on which the part is fastened is driven slowly, by a motor. The maximum deflection of the beam shown in Fig. 7 occurs at two points during a cycle of revolution. Once, *F* when the heavy point is farthest from the fulcrum, and again *N* when it is nearest. In these positions the heavy spot is at the opposite extremes of the horizontal axis of the unbalanced part. The driving of the part by a motor merely accelerates production. The operation remains static balancing.

To balance the part, material may be added or removed, so that the weight added or removed, multiplied by its distance from the axis, will equal the original unbalance as indicated by the dial, which is in terms of ounce-inches. When the work is statically balanced the scale beam will remain stationary. This is the Olsen-Lundgren type of static balancing machine.

The evolution of balancing follows closely that of weighing. First the balanced stick, then the steelyard, the counter scale and finally the compound lever track scale. Static balancing machines follow exactly the same order.

For heavy parts, the weights necessary to balance the work when supported at one end of a class one lever with two equal arms would be too great for practical use.

Thus, in the Martin type of static balancing machine, Fig. 8, the bearings in which the work to be balanced is swung are so near the fulcrum or knife edges that a substantial part of the work extends past the knife edges. Under such conditions the work is almost self-balancing and only a comparatively short arm is necessary to counterbalance the load. On this arm are three weights: One near the farther end to counterbalance the load so that the arm will oscillate up and down with the load in equilibrium with its heavy side down. Another weight is



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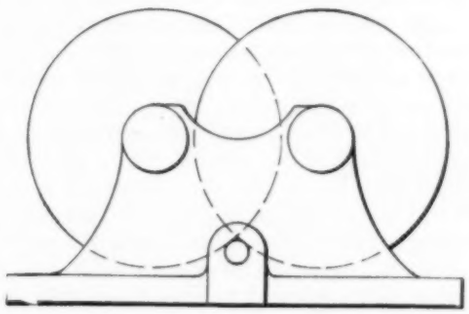

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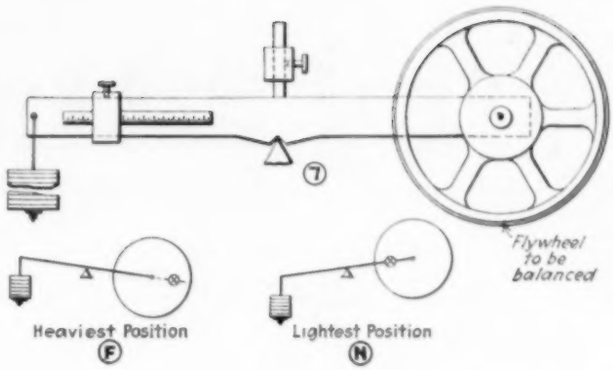
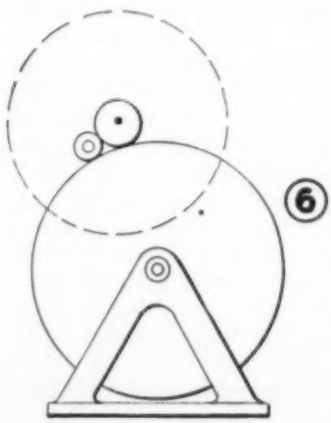
above and in line with the knife edge. Raising or lowering this weight *P* shifts the center of gravity and adds to or detracts from the sensitivity of the oscillation, but does not affect the balance. Both of these weights are adjusted until the arm, with its load, swings gently up and down. The swing above center must equal the swing below the center mark. To measure this swing, a vertical scale is provided where a pointer on the end of the arm will indicate the amplitude and balance of the oscillation.

In operating this balancing machine, the rotor, resting in half-bearings, naturally comes to rest with the heaviest part down. A vertical line is drawn from *B* to *D* on



the work *A*, the rotor is turned 90 deg. and the small weight *C* is moved back and forth until the weight bar oscillates between the same two lines on the scale at the end as it originally did. By measuring at four intervals of 90 degrees, we not only find how much the work is out of balance in terms of lb.-in., but we find the radius and plane at which the unbalanced couple occurs, and can, if necessary, remove metal from more than one place in order to place the part in balance. It is not always necessary when using this type of balancing machine to remove the same weight of material as the quantity that causes the unbalance. For instance with the heavy part down, we may place five pounds on one side of a vertical axis and ten on the other side. The five pounds being far enough away from center to balance the ten pounds. The heavy spot is not always at the bottom of the vertical axis. Static balance merely establishes that the heaviest half of the rotor is below the horizontal axis. There is a large difference, as far as running balance is concerned between the two conditions. Weighing at four points allows of working out by triangulation the exact location of the heavy point or points, and the out of balance can be rectified in two or more axes. By using a scale on each end or possibly by reversing the work end for end and repeating the weighing process, it would be possible to locate the out of balance condition along the longitudinal axis of a drum. Under these conditions the balance secured would not differ from dynamic balance.

Where the object to be balanced weighs 100 tons or more, the same principle is used, but the work bearing is placed almost directly over the knife edge as in Fig. 9. This makes the balancing even more sensitive than on the machine previously described and changes the lever to class two which allows for compounding. This would seem to establish a rule that the larger the part to be balanced, the nearer the center of the balance machine it must rest. This is only incidental as far as balancing is concerned, the real reason is that the machine occupies less floor space and the mechanical control of the part being balanced is simpler. The weights necessary to counterbalance a 120-ton turbine, supported on one of two equal legs, would be too great for practical use.



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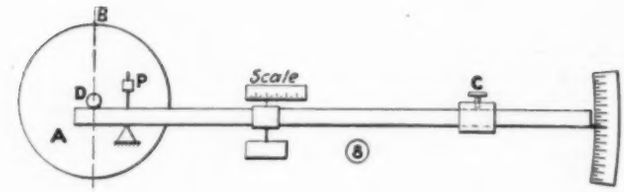

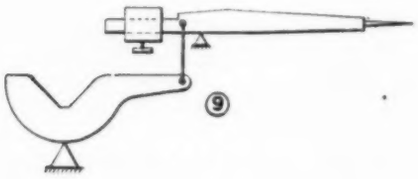

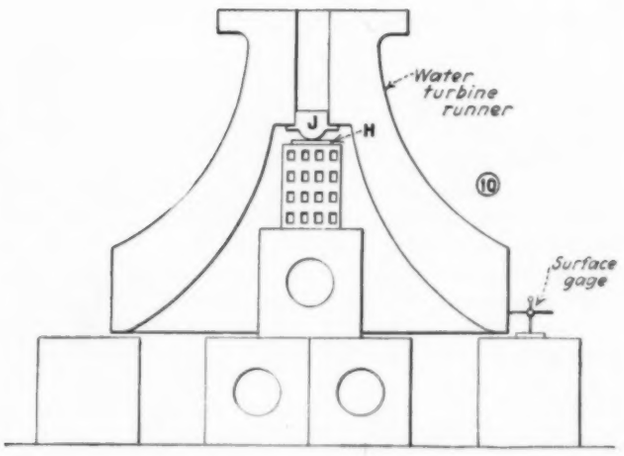

but with the weight directly over the fulcrum the control levers can be compounded and relatively little floor space is required.

We now come to the vertical type of static balance. Generally speaking, the relation of this type of apparatus to the horizontal type of balance is the same as the relation of the boring mill to the lathe. Parts that can best be turned on a boring mill are usually best balanced on a vertical apparatus. The same restrictions apply in vertical as in horizontal static balancing. That is, a part balanced statically is not necessarily in a state of dynamic balance.

The sensitivity of vertical balance depends upon how close the center of gravity of the part being balanced is to the fulcrum upon which it is balanced. I have balanced a 40-ton hydraulic turbine so that a pound or two at the outer rim would move it. It has been pointed out that with horizontal balancing ways the indication was merely that the heaviest half of the part was below the horizontal axis. With the vertical type the heaviest part is definitely the lowest because the work is balanced through a plane that is parallel to the normal axis of rotation, while in the horizontal balance machine the plane is vertical to the normal axis. There are several designs of vertical balancing machines. Those on which the part to be balanced is directly placed, and those where the swinging member is part of the balancing machine. In this latter case the swinging member is merely a fixture to hold the part being balanced. The only special parts needed to balance the water turbine were the hemispherical fulcrum plug *J*, Fig. 10, and the hardened plate H upon which the fulcrum rested. The rest was shop equipment.

Balancing a crankshaft and flywheel would be of little use if the connecting rods and pistons connected to it were of varying weights. As the motion of one end of the connecting rod is circular, it is equally true that if the lower ends of the rods were of different weights they would also throw the crankshaft out of balance. To take care of this they are balanced upon a twin scale device. A standard connecting rod is placed across one arm of the two scales, the crank end on one, and the pin end on another. On the front arms are guides that register the rod to be balanced in the same plane, and parallel with the standard arm. There are two scale pointers which indicate whether the weight of the two rods are equal or, if not, which end is over or under weight. Balancing devices are indispensable to quality manufacture of rotating parts.

Accuracy in Gear Gaging—*Discussion*

GEORGE BELBES

In Vol. 74, page 325, J. A. Potter elaborates quite ably on the subject of gear gaging. His derivation of the formulas and their application is worthy of best consideration. However, the writer, having studied gearing theoretically and having had considerable experience in cutting and checking gears, is of the candid opinion, that after all, the good old fashioned "run-around" gage, which Mr. Potter discredits, is the best and most reliable if used intelligently by men who know gearing.

In accurate gearing, a matter of 0.0002 to 0.0003 in. discrepancy in the pitch or the tooth thickness would be enough to cause objectionable trouble. A very small error, or a slight inaccuracy in manipulating the tools and formulas involved in Mr. Potter's method, would more than introduce this amount of error. Gear gages constructed on the mesh principle, particularly, if they embody means of mechanical rotation and afford application of loads by means of brakes, are especially good for testing gears.

I am strongly under the impression, that after one has calculated the gear elements in question, he would hesitate to wager that the gears would run properly; and he would be tempted to use a "run-around" gage if it were available to counter-check himself. Mathematics, while a powerful and indispensable tool in engineering, must at times yield to something more tangible.

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Gaging finished parts isn't always easy even when they are perfectly plain. Shafts have sometimes been rejected as small because a snap gage would slip over without forcing. In other words, the pressure of the measuring points affects the reading of the size. Ratchet micrometers are a step in the direction of uniform pressure, but to permit comparison the pressure that can be exerted should be uniform. This is particularly important in measuring materials that are easily compressible, as tinfoil, plastics or the like. Will we come to gages with a standard measuring pressure, or are optical methods likely to be more widely used?

Pressure-Forging Gear Teeth

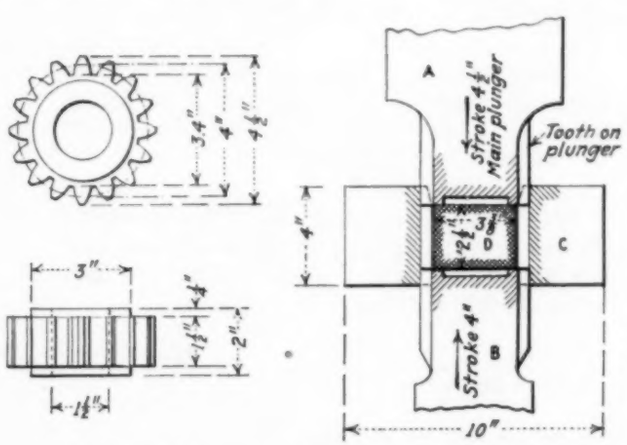
Nickel steel blanks are upset to fill out a die, and then accurately finished in a rolling machine

JAMES R. CORNELIUS
Warks, England

RECENTLY an order was placed for a quantity of nickel-steel pinions with the specification that the teeth were to be work hardened before delivery without the usual wear that accompanies this state. These pinions were as shown, being 4½ in. outside diameter with 16 teeth 4 D.P., a 20-deg. pressure angle, width of tooth 1½ in. and a hub on each side of the pinion 3 in. in diameter and ¼ in. thick.

To produce these gears in the usual way was a simple matter and to run them in to get a hard skin was even more simple, but to do both and deliver the consignment with the same uniform accuracy as given by the gear generator was a poser. Tests were made to find out just how much could be left on during machining the teeth to allow for subsequent wear, but this was found to be uneven, also owing to the slightly different pitch diameters obtained, the wear did not appear to occur over the whole tooth flank. Even with those gears that did harden up, which by the way, took an extremely long period, a final pass on the hobbing machine was necessary to regain a true pitch diameter, and this undid all the previous work by taking off the majority of the hard skin.

Our second attempt was at tooth generation by hot rolling. This was carried out in two operations, viz: roughing to obtain the compressed metal necessary to give a hard, strong tooth with the densest grain where most needed, and a finishing operation at a low temperature to produce the accuracy desired. Here we were again balked. We possessed a heavy rolling mill capable of producing a pressure of some 200 tons, and after generating a rolling hob, we geared up the two shafts to their working ratios. These were those of the gear to be produced and the hob, actually 16:32. At engagement the hob bit well into the blank, which was jammed well up between two flanking plates to allow of no expansion, and commenced the teeth, but owing to the difference of pitch between the tooth points of the generating hob and the blank diameter, a certain amount of creep became apparent and caused the fibers of the teeth thus formed to open at the center of the tooth. This was found to occur after the first operation when two gears were split open and tested for microstructure.



At the left is shown the pinion that was forged and on the right a diagrammatic sketch of the die, press rams and pinion blank. The lower plunger *B* is used as a knockout

At a loss for the moment, we determined to utilize a 500-ton press and to form the teeth hot under pressure in a forming die. Three pieces were made. These consist of the top plunger *A*, the bottom plunger *B* and the ring *C*. The two plungers were machined with teeth on their peripheries that fitted fairly closely in female teeth in the ring. Both plungers were recessed to form the bosses on the gear, and all three parts were hardened and tempered. In the press, the top plunger was actuated by the main ram with a pressure of 500 tons, the ring was held stationary on the bed plate, while the bottom ram held the lower plunger in the position shown, allowing it to rest on a bolster to withstand the full pressure of the upper ram. The blank *D* was inserted in the ring at a temperature of 1,650 deg. F. and the ram *A* closed on it. The blank was squeezed until the teeth were pressed out and all cavities filled in the die. To determine when this occurred the operator opened the pressure valve and held it open until the gage needle pointed to supply pressure. If shut at this moment and the pressure dropped, the metal was still being compressed and the valve was reopened until no further deflection of the needle occurred. The bottom ram was then lifted by means of the ejecting plunger and the swaged blank released.

When cool the gears were set up in a fixture, located from the teeth, and bored out to $\frac{1}{32}$ in. under finished size. They were then heated to 750 deg. F., mounted on a mandrel and set up in the rolling machine. Here the master gear was geared up to the mandrel and the press ram driven in to correct depth as soon as the machine was set in motion. At this temperature the metal, being fairly elastic, gave to the hardened teeth of the master wheel and were rolled to finished dimensions. The master wheel was made so that it functioned exactly as would a generating hob on a Fellows gear cutter, producing properly proportioned teeth with normal addendums and dedendums. By means of this last method the gears obtained were quite satisfactory and when tested for structure were found to be close grained along the tooth surfaces with a relatively normal grain structure at the tooth center.

The Foreman's Round Table

Service or Ability

"HELLO, Al, what've they got good to eat today?" hailed Ed as he sat down beside his friend.

"What difference does it make to you? You always order ham and eggs anyway."

"Well, I always like to know what I could order if I wanted to. I feel like celebrating today. I hired three men. Three, count 'em. It looks like the end of the lean years."

"Who are they, breadline bo's, or some of our old men?"

"Neither, strange to say. Looks like our old men had left town. These three look like pretty fair men. One of them looks particularly good. I think maybe he might make a good assistant. You know I never did fill that vacancy yet."

"No, I know you never did, and believe me, boy, you were lucky that you didn't, and I think you'll still be lucky if you leave it unfilled."

"Oh I don't know, if a good man comes along I am going to grab him and I think maybe I've got him."

"What is this guy's history, Ed? Did you look it up?"

"No, I don't care a darn about his history. A man can create his own history, but his present is public property. I'm after performance, not fiction, and this guy performs."

"Nevertheless, Ed, it might be a good idea to talk it over with Williams before you commit yourself. It is a pretty broad question whether to put a new man immediately into the line of promotion, even if he has occupied an important position somewhere else. It makes other men think that service don't count."

"Why should it? I am not looking for a man that has been with the company for a long time, I'm looking for a good man. If one of the guys I hired today is good, he is the man I want."

"Well, that may be all right too, but doesn't length of service and experience mean anything to you?"

"Not a darn thing, and certainly not as an alibi for inefficiency. You're as bad as Ike Stannard. He was complaining that I gave him all the bum jobs, and said that his eleven years with the company entitled him to some consideration."

"What did you tell him?"

"I didn't tell him anything. I asked him if he had ever thought that maybe he had been here eleven years too long?"

"That wasn't fair, Ed. Ike is a good old scout."

"Sure he is, but why should everyone get the idea that the company owes them something just because it has given them a good steady job for a long time. Seems to me it ought to be the other way round. Whichever way it is, it don't bind me."

"Well, it don't matter anyway. We are not discussing length of service, but whether a new man shall be placed in the line of promotion immediately, or whether an older man shall have preference, and to what degree."

"If this man is as good as I think he is, what good will it do to wait six months or a year before we decide to promote him or not? And in the meantime we lose him, maybe."

"Well, suit yourself, Ed. But if it was me, I'd do two things: I'd look up his record, and then I'd have a talk with Williams. Foremen don't settle matters of policy."

Suggested by W. E. Warner, Herts, England.

How nearly related to the hiring of outside men for executive positions is the stand taken by Ed? Are we overdoing the continuity of employment idea, and thereby lowering the average of ability in the shop?

Discussion of Former Topics

Service de Luxe

Three years ago I had to discharge a tool-crib attendant for refusing to give out tools before the starting whistle blew in the morning. I learned, then, that there were men who were willing to start early. As for turning in tools after quitting time, the answer is—No. A few men will start early. I have yet to meet the man who will work up to the whistle. All the boys cut that quitting corner close.

I know of no scheme that will keep men on their toes up to the quitting whistle. Threats certainly won't accomplish it. There is one idea that works splendidly, and I have employed it on a few occasions. The trouble is that the management will never countenance it on a large scale. The idea is this: suppose a job exists that under ordinary conditions will not be finished that day—go to the men and tell them they can go home as soon as the job is done. That job will get done miraculously. You won't hold the men till the quitting whistle, but you'll accomplish the same result by achieving the impossible. It is understood, of course, that if the men go home early they are still paid for the full time.

—James K. Matter.

Slowing Down

We have slowed down in our plant. That applies to each and every one in the plant, the sweeper, day laborer, pieceworker, foreman and superintendent himself.

It's nothing to be proud of and we are not fooling ourselves into thinking that our plant has escaped the general letting down that prevails in industry today.

Why shouldn't there be a slacking of production? Why should the men strive to get the work out quickly and then be told that on account of depression, lack of business and unfair competition, it will be necessary to reduce the rates or cut the hourly wages?

The foremen are coddling certain men. It is easier to do this than to drive them. Some of the men have the foreman bluffed in so far as the operation of certain machines is concerned, and these men get by with murder.

The foreman is held to account if the work does not get through his department on time and at the right cost. He will suffer the loss of a certain amount of his self-respect in order to hold his job and keep the boss off his neck; anything to keep the men lined up for uninterrupted production.

The foreman with backbone is the key man of the organization and the success of the plant depends upon the percentage of such men. Our management is encouraging the training of such men because we need them.

—E. F. Werner.

Taking a Gamble

Joe, like everyone else, runs a risk when he answers an "ad" to a hoax number, for if his letter had not got to his own company it might easily have got into the hands of the president's cousin or brother-in-law, or husband of one of that gentleman's wife's bridge friends! So if he has offered to sell the company he is working for or has been unwise enough to make disparaging remarks about its management he will only get what is coming to him. When trying for a job it is quite possible to make an application which contains some little subtle flattery of the company by which the applicant is employed and to call attention to one's excellencies without reflecting on the stupidity of superiors in not having recognized it. Such an application, read by a reasonable man, should not fail to call favorable attention to the applicant.

—H. J. Burnham,
Birmingham, England.

Rules is Rules

A rule may be defined as a conveniently summarized order sufficiently general in its meaning and in its wording to be applicable by the average person to the average case requiring action, be it positive or negative. A host of safe-guarding clauses in the legal style will defeat the object of such rules, which is to indicate clearly and not obscurely. What should stand out essentially in all rules is the spirit behind their formulation. Rules must be read with regard to the spirit and not acted upon according to the exact letter. Williams' views on consistency deserve a wide publicity and perhaps rather more in the office than in the shop.

—S. A. Knight, *Kirkuk, Irak.*

Direct Action

It all depends on which side of the fence you happen to be. If you are one of the production staff, it is a constant source of annoyance to observe the higher status usually enjoyed by the accountant's staff.

If, on the other hand, you happen to be on the accountant's staff, you resent the implication that anyone connected with production can possibly be of sufficient importance to claim equality.

Looking at the matter broadly, there are three main factors in the control of any manufacturing organization, and, irrespective of their relative importance, these are: design, accountancy and production.

The relative importance of these factors depends entirely upon the size, operation and product of the concern. In a small concern it is possible that production may be an easy first, with accountancy second, design being negligible. Going to the other extreme, in a large concern with wide ramifications and branches in various countries, the accountancy factor is of paramount importance.

Design comes into its own where the concern is dealing with work of an experimental nature, or where the product is made rapidly obsolete by the vagaries of public demand.

The importance of the individuals governing these factors must therefore vary with each concern, and generalization is practically impossible.

It is possible, however, to weigh

the qualifications necessary in these individuals, and from these to form something of a conclusion on the point. The chief of design should possess a high degree of technical knowledge and be conversant with modern developments. The chief accountant's qualifications should be absolute integrity and business knowledge. The production manager requires driving force combined with technical and practical ability. Considered as marketable commodities, which of these is the most valuable?

—A. WILLIAMS,
Chief Estimator and Rate Fixer,
Bristol Motor Works,
Bristol, England.

Tolerances

Some shops seem to have two sets of tolerance standards, one to put on the drawing to fool the customers into thinking that they are getting exceptional workmanship, and another standard for the shop to work to. The first is used for advertising and the second for production. The first is impractical and impossible with the production methods used, the second is practical and within commercial limits. The first is written, the second is implied.

It is rather difficult to explain this system, but there seem to be a number of reasons for it. In some cases it is the man in charge of the shop who has a foolish pride which will not allow him to admit that his department is incapable of some things. In some cases it is the sales department which is afraid to tell the customer for fear that a competitor will agree to comply with the specifications and thus get the order. In other cases it is plain ignorance, which goes so far as to place tolerances on dimensions which are purely theoretical and impossible to measure.

—C. A. E. JOHNSON.

Who Pays the Bills?

At the plant with which the writer is connected, when a man loses a tool he is not given his check for a week or two and a report is sent to his foreman asking that every effort be made to find and return it. If not found, and it usually is, his check is given to him and he does not have to pay for the lost tool except in rare instances. If a man is continually losing something through carelessness or indifference and will not respond to reprimand then he is made to pay as a means of forcing him to realize the value of the tools he works with and the necessity of taking care of them.

We have used the double-checking system for several years and have found it a great improvement over any method we tried before, of handling tools in the crib. It does not take so long to break in a new man to work in the crib because he does not need to memorize so much. He makes mistakes, but not nearly so many as with other systems. If there are any other systems in use which are as good and are less cumbersome we have not learned of them.

—ROGER ENGLISH,
Relays Motor Corporation.

Advice, Gratis

Advice, like fiction, must be taken with a grain of salt, and given in a like manner. There are precious words which fall from the lips of wise men, and there is the blatant echoing of the man with the large ego. Ability to differentiate between the two is given to few of us.

Unfortunately, most of us think we have that faculty which enables us to look at the circumstances surrounding the troubles of another with an all-seeing eye. This, we think, assures us that we have the only clue to the solution of an intricate problem. This clue we take and mold into an essay which we tender to the unfortunate victim, to the detriment, in many instances, of the original problem.

No definite rule can be laid down on how to give or accept advice. But we can all help the condition if we use good judgment.

In the first place, when giving advice, be sure that you are qualified to talk on the subject in question. The reverse of this applies to receiving it. Know definitely, before you accept it, that the giver is qualified on the subject, and not simply "talking through his hat."

Then, when you have accepted it, modify it to suit your particular instance. After all, each of us thinks that his own opinion is as good as, if not better, than the one who is giving the advice.

—PHILIP DEL VECCHIO.

Slowing Down

Al's statement that industry is over-crowded with pacifists and philosophers, and its subsequent explanation, is rather obscure. I would say that we do not have enough philosophy. What, really, is the final objective of our rushing and crowding in industry? How many take enough time from their mad rush to ponder over this? Does it not seem that the ever-increasing mad rush for profit is nothing more than a blind chase in a vicious circle.

If workmen are slowing down, what of it; what is the good of this mad speed? Where does it lead to?

Perhaps our present depression is after all not the result of over-production. Perhaps a little more philosophy in place of profit would make us realize that there is plenty of productive capacity, even without rush, to fill all needs and our requirements.

Guess again, Al, and perhaps you will hit upon the right thought, that it is not insufficient production that ails the world, but that it is our inadequate system of distribution of products, which our present machine age so easily and plentifully produces.

—KARL MERTING, *Tool Foreman,*
C. B. & Q. R.R. Company.

Taking a Gamble

Whether of high or low status, it is quite in order to apply for a job for which one is especially fitted. Qualification is the vital thing: other considerations can be ignored. Firms who advertise confidentially, should and would, treat answers in confidence. Only on rare occasions would applying lower a man in the opinion of his employers, providing the application is worded truthfully, and the man's character coincides with it.

Ambition to attain one's rightful sphere is legitimate, and is so recognized by leaders of industry. Capable men are being overlooked daily in various works, and employers advertise positions for which the very men are ready to hand if they but knew it. When thus brought to their notice, few employers would victimize the man. Certainly the applicant would gain by it sooner or later.

—WILLIAM BRYCE,
Sheffield, England.

Flood lighting, bright interior finish, convenient equipment layout, and modern machine tools have made a new shop from an old one

Relocation, Rearrangement, Re-equipment

THOMAS O. FORD

The three R's take on a new meaning in the plant of a Worcester manufacturer. What has been a depression for others has been an opportunity for plantwide modernization in the Norton Company's machine division

ADMONITIONS to put the shop in order during periods of business slackness have been so many times repeated that much of their force is lost. Even those, who after the dull years of 1921 and 1922 found themselves unprepared for the boom times that followed, refuse to profit by experience, and all too often have adopted a program of watchful waiting. In fact, some of our more cynical manufacturing executives, ignoring past history, appear to regard stories of replacement programs as propaganda sponsored by equipment builders, to be taken with at least one grain of salt. "Why," ask these unbelievers, "don't these machine tool fellows practice what they preach? If plant modernization is so good, why don't they begin at home?"

The answer is obvious. That is exactly what many equipment makers have done. They have taken this opportunity to mend their fences by rearranging plant facilities and by weeding out old equipment. Many examples might be quoted—a case in point is the Norton Company, of Worcester, Mass. This company makes abrasives as well as machinery, but the following description will be confined to that portion of the plant devoted to the manufacture of grinding and lapping machines.

To understand fully the problem encountered, some idea of this firm's background will be of value. The Norton Company started the first year of the century with one shop, or mill, in accordance with New England parlance, for the manufacture of grinding machines. As industry accepted its product in increasing quantities, additional mill units were constructed. At the time of building, each was provided with modern machinery and represented the last word in efficiency. The result was six mills, five two-story structures arranged in parallel and one six story structure at right angles to the five others as illustrated.

Strategically located between the machining departments, the erecting floor facilitates a unidirection work flow; accessible to it are the stores and inspection departments

An industrial track answers the need for heavy part transportation. This straight path, connecting five mills, is a new addition contributing to simplified material handling

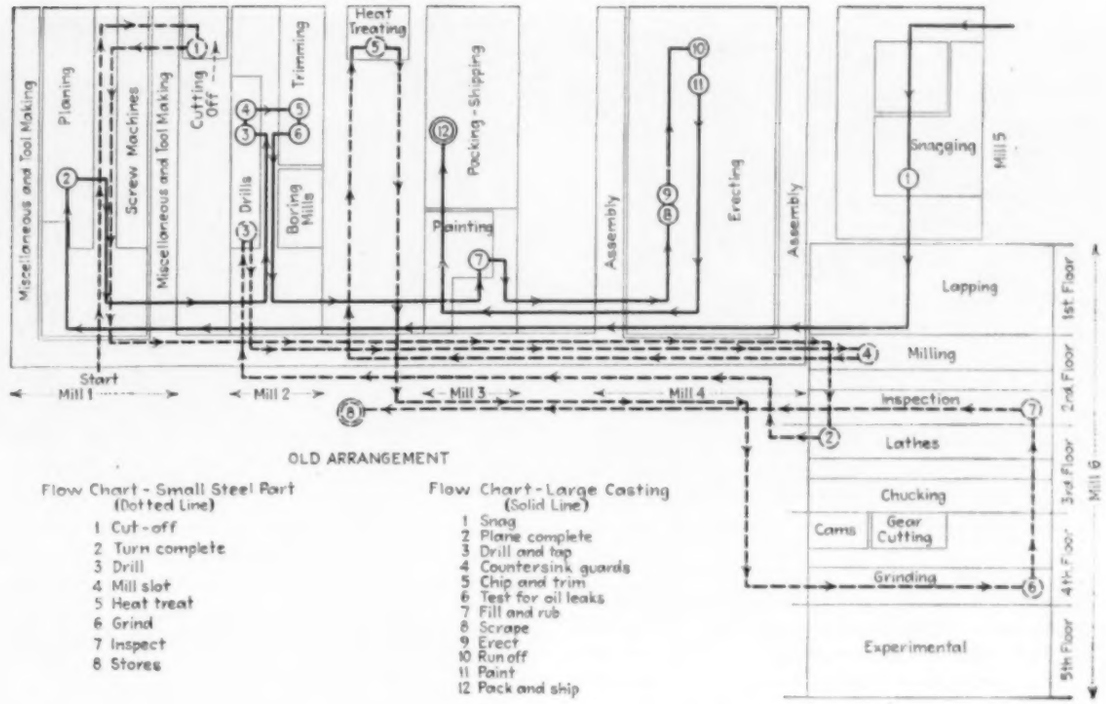
The layout then was the result of progressive additions rather than the carefully conceived plan of a unified manufacturing plant. The pressing demands for greater production prevented any attempt at rearrangement until 1929 when the management approved a plan to coordinate the six mills into one harmonious metal-working plant.

Like most machine tool builders, the Norton Company does not operate a production shop. The wide variety of sizes, types, and drives in its product, renders long runs on similar parts impossible. Straight line production, such as is known in automotive shops, is out of the question. Despite this handicap, Norton succeeded in achieving a layout that simplified routing, material handling, and all steps in the making of its machines.

A comparison of the two layouts illustrated furnishes a vivid picture of these accomplishments. Each plan view depicts the routing of a typical heavy casting (in solid lines) and a typical light steel part (in dotted lines). The drastic simplification in work progress is self-evident. Few venders of patent medicines can display a more striking "before and after taking" achievement.

Naturally, in diversified manufacture, there is a wide variation in the routing of material. Neither of the lines, shown in the layout plans, represent any great number of parts.. But they are representative of average work pieces and are not hand-picked demonstrations of extreme conditions. In general, under the new arrangement, Mill 1 contains the receiving department and the starting operations—snagging, cutting off, screw machines, and lathes. Mills 2 and 3 include the intermediate machining operations; Mills 4 and 5 the erecting and shipping departments. In Mill 6, is located the lapping machine assembly, inspection, stores, and experimental departments.

What look like aisles in the plan views, outside the double lines, are in reality galleries which extend over the main bays. For the sake of clarity, the rules of architectural design have been ignored to give a com-



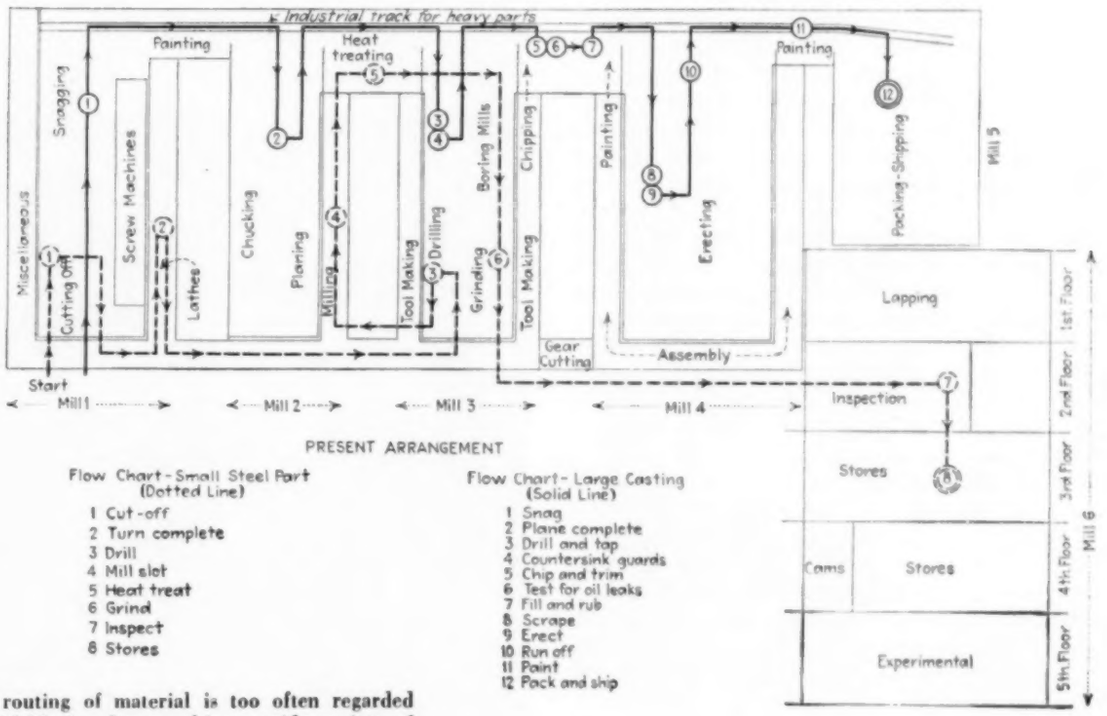
OLD ARRANGEMENT

Flow Chart - Small Steel Part (Dotted Line)

1 Cut-off
2 Turn complete
3 Drill
4 Mill slot
5 Heat treat
6 Grind
7 Inspect
8 Stores

Flow Chart - Large Casting (Solid Line)

1 Snag
2 Plane complete
3 Drill and tap
4 Countersink guards
5 Chip and trim
6 Test for oil leaks
7 Fill and rub
8 Scrape
9 Erect
10 Run off
11 Paint
12 Pack and ship



PRESENT ARRANGEMENT

Flow Chart - Small Steel Part (Dotted Line)

1 Cut-off
2 Turn complete
3 Drill
4 Mill slot
5 Heat treat
6 Grind
7 Inspect
8 Stores

Flow Chart - Large Casting (Solid Line)

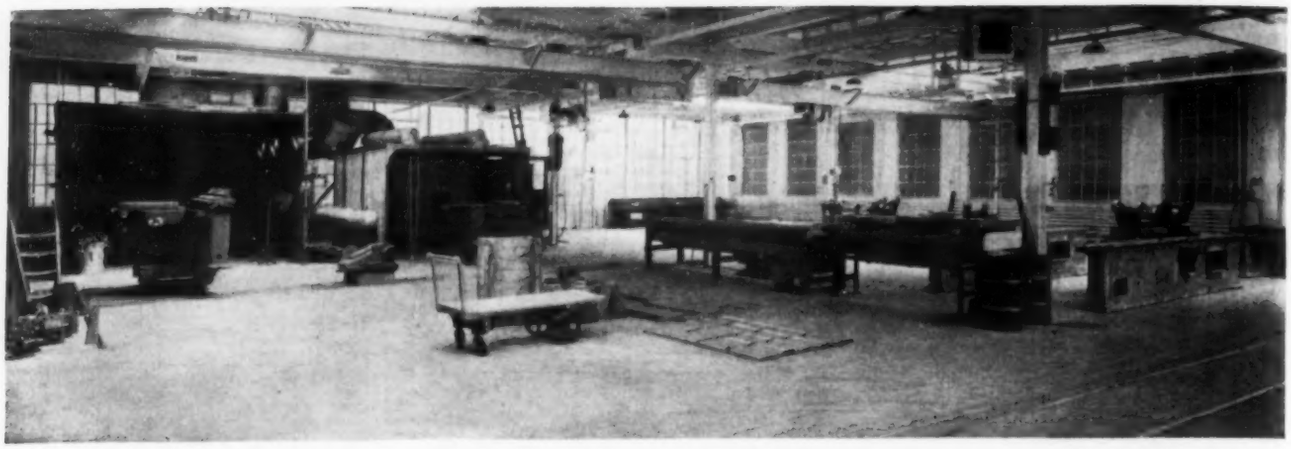
1 Snag
2 Plane complete
3 Drill and tap
4 Countersink guards
5 Chip and trim
6 Test for oil leaks
7 Fill and rub
8 Scrape
9 Erect
10 Run off
11 Paint
12 Pack and ship

Devious routing of material is too often regarded as unavoidable in plants making a wide variety of product. A comparison of the progress of identical parts before and after rearrangement graphically demonstrates the remedy

plete view of the layout in one plan. It will be noticed that all manufacturing operations are confined to two floors.

Formerly all material was transported by industrial trucks from one mill to the other through the connecting cross aisle at the north end. The addition of the industrial track at the south end, connecting Mills 1 to 5, greatly facilitates the handling of heavy work. The north aisle is still used for the lighter parts. For this reason, the machinery for work on heavy parts is located at the south end of each mill with that for light parts at the north end. The net result has been a simplified flow of material, eliminating the crisscrossing of light and heavy work.

One remarkable feature of these changes is the increase in plant capacity gained without adding to the floor space. This extra capacity amounts to 25 per cent over the former basis. In fact, this gain was made with an actual saving in space leaving several bays free for additional machines. It is estimated that when needed



Between Mills 3 and 4, parts are chipped and given the priming coats before going to the erecting floor. Light and cleanliness are in evidence here as in all parts of the plant

another 20 per cent increase in productive capacity can be made available by utilizing this room.

The improved plant efficiency was not caused by rearrangement alone. New machine tools contributed to a large extent—over one hundred major units were purchased in the last three years. This equipment was not selected on the basis of straight replacement but only after a thorough reanalysis of each machining operation. New ways of performing the work were studied and adopted. Parts were redesigned to eliminate some operations and to simplify others. Machining time was reduced with the result that fewer units of equipment were needed in many departments. Four new chucking machines replaced seven old units; in another instance, four turret lathes replaced eleven old units. In Mill 2, two new planer millers have supplanted four old pieces of equipment. And so on through each department runs the story of savings. Norton's machine tools now have an average age of 8.9 years which, according to *American Machinist's* inventory of Metal-Working Equipment, is well under the average for the industry. Much of the economy in floor space is directly traceable to the superior performance of the new tooling.

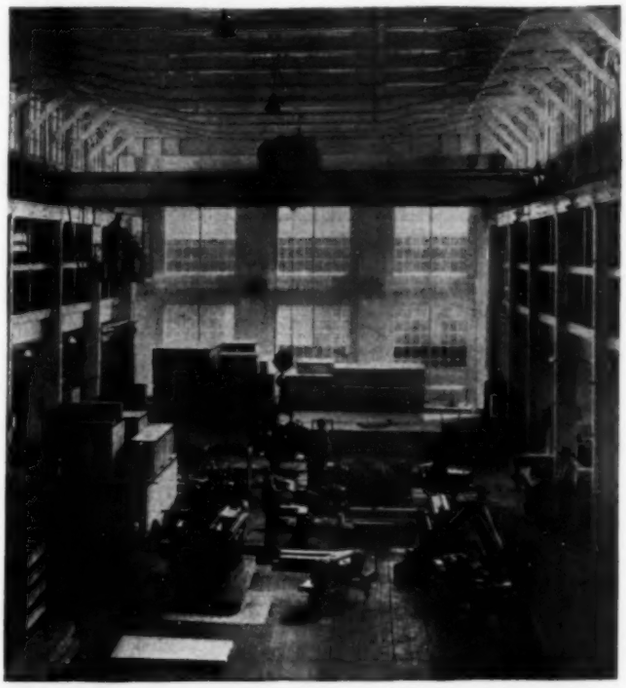
A system of decentralized tool cribs has materially reduced set-up time in the machining departments. Nine tool cribs supply the six mills and are strategetically located with an eye to accessibility. Old racks and storage systems have been thrown out to give way to modern pressed steel units. This change has been effected for finished part stores as well as for the tool cribs. The steel bins permit of flexibility in arrangement and promote cleanliness.

An important phase of Norton's new set-up is the rather unique provision for applying finish to the product. Lacquer has been accepted as a standard—its application is completed in three steps so fitted into the line of production as to avoid side tracking and duplicate handling. The first paint booth is located between Mills 1 and 2. Following the snagging operation, the castings are filled and sealed. Between Mills 3 and 4, after machining but before erecting the priming coats are applied. The final finish is given between Mills 4 and 5, where the assembled machines pass from the erecting floor to the shipping department. Thus the finishing operations are dovetailed between the other steps of manufacture in a logical sequence.

Particular attention has been given the workman's surroundings. Plant lighting has been improved to such a degree that the old portables that illuminated one spot on a machine have been eliminated. The general system of flood illumination provides ample visibility for each workman. A minimum of 12 ft.-candles is maintained at the working level. Only at machines, where operations must be performed inside the work, is auxiliary lighting necessary. Here convenient plug-in sockets are provided for portable lamps. However, the natural illumination is such that artificial lighting is required only on extremely dark days.

Finish is applied without interrupting the line of progress. This particular spray booth, lying between Mills 1 and 2, is where the castings are filled and sealed

Good housekeeping extends to the store rooms. Steel racks provide economy of space and flexibility of arrangement



And so to the customer—a product that is better for being processed right

Clearness of vision is aided by the interior painting of the mills. To a height of five feet, the walls have a dado of aluminum paint. Above this line, the walls and ceilings are finished in mill white, which has high reflectivity. In the heat-treating department, all equipment is finished with aluminum. Elsewhere the standard blue-gray is used for machine tools. The whole effect is one of light and cleanliness, which is further augmented by ample aisle space and by good housekeeping in the mills.

Norton's far-reaching modernization plan has taken two years to complete, if such a program can ever be called completed. It took courage to back up the constructive ideas behind this change with hard-earned dollars. But the company has the courage of its convictions and the wisdom to adopt the long view.

Even during the present period of limited production, the plan is paying. The gains come in part through machining and routing savings that were estimated in advance. But equally as great are the effects of those intangibles that are fostered by an atmosphere of efficiency. Modern machines and small tools, readily available clamps and fixtures, and pleasant surroundings have given the workmen a new zest in their jobs. The consciousness that they are members of a well organized shop, has dispelled that sense of ineffectuality that men feel when working against odds beyond their control.

Marking Steel with Acid

A MARKING fluid that will flow like ink and may be used with a pen or rubber stamp in marking steel is composed of the following ingredients:

Nitric acid (38 deg. Baumé)	75	parts
Nitrate of silver	2	"
Water	23	"
	100	

A new steel or brass pen may be used. In the latter case brass is deposited. In using a rubber stamp, the pad used for inking should be of blotting paper or thin sheet asbestos. The pad should be placed on a piece of glass to prevent acid getting on the bench or table.

The marking with either pen or stamp should be clear cut. If the fluid tends to run, add more water to the solution. The marking may be cleansed with water, or the acid may be left on. Rubbing with an oily rag immediately after the acid is dry will prevent any tendency to blur as time passes.

After using, the pad should be destroyed and the stamp washed in clear water. Pen points are not of much use after having been used for this purpose.

A Japanese Plant—*Correction*

Through a misunderstanding the gear cutting machine in Fig. 3 of the article (*AM*—Vol. 74, pp. 936-937) was called a Sykes. This machine was, we are informed, built by the Power Plant Company, Ltd., West Drayton, Middlesex, England.

Marmon Sixteen Cylinder Heads, Sleeves, Tappets

CYLINDER heads of the Marmon Sixteen engine, like the cylinder blocks, are of Lynite. They are milled at the same time as the cylinder blocks on alternate fixtures as previously described. The joint surface is lapped after which the stud holes for holding down and the push rod holes are drilled. Using a trunnion fixture the holes for the valve stem guides are drilled, fly cut and reamed.

The dome of the combustion chamber is next roughed and finished as in Fig. 1, great care being taken to secure the same amount of compression space in each. The fixture is very rigid both for supporting the work and for guiding the tool. It is moved by the lever in front and accurately indexed from hole to hole. Clearance for the valves is then profiled and the spark plug holes are drilled. The valve opening is fly cut and counterbored and spark plug holes tapped.

In sizing the recess for the valve seat a special hand fixture is used as in Fig. 2. This fits the dome and secures a uniformity that is very desirable as the seats are shrunk into place. Details of the fixture are seen in Fig. 3, which shows both the guide and the ream on its arbor. A bayonet lock holds it and allows for easy removal.

The seats are of aluminum bronze and are made 0.006 in. larger than the recess or counterbore that is to receive them. The cylinder head is heated to 600 deg. F. on a cast-iron plate 2½ in. thick in a gas-fired furnace. This plate is removed from the furnace with the cylinder head which remains on the plate while the valve seats are being put in place. The heat stored in the plate prevents the head from cooling before the 32 valve seats are all in place. On cooling, the seats are practically a part of the cylinder head.

Then the valve stem guides are pressed in and reamed, and the head is ready to go to the line for final assembly.

Shelby tubing of S.A.E. No. 4615 steel specifications is used in making the sleeves for the new Marmon Sixteen engine. These are cut off with a Cochran-Bly saw, held in an air chuck on a Potter & Johnston, rough bored, faced on one end and chamfered. They are then carburized but not quenched and go on a mandrel to have the outer surface removed and to form the flange

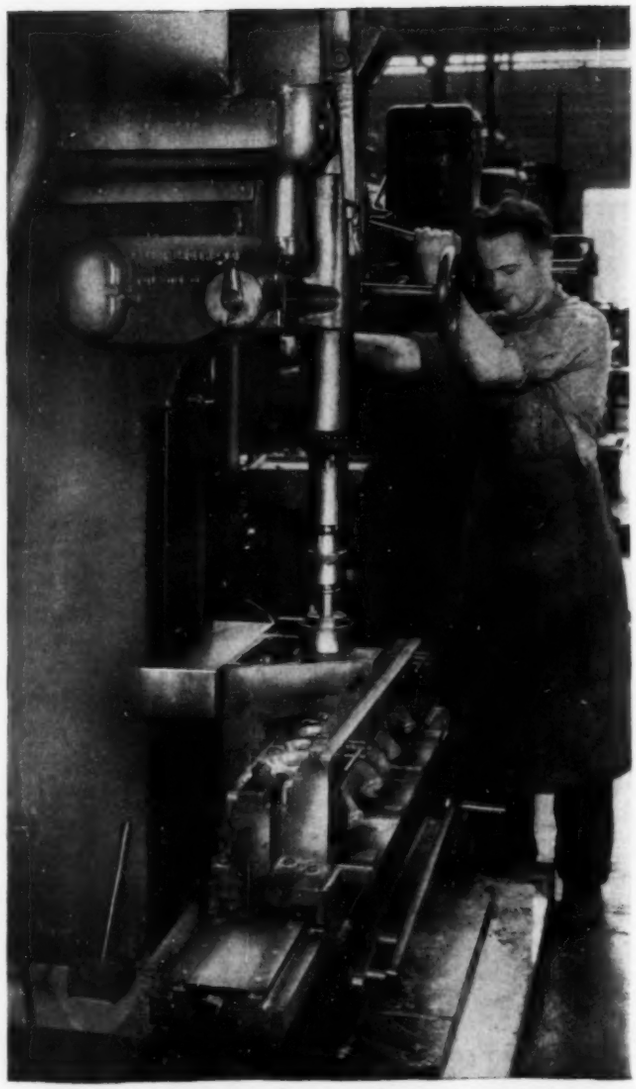


Fig. 1—Machining the dome of combustion chamber

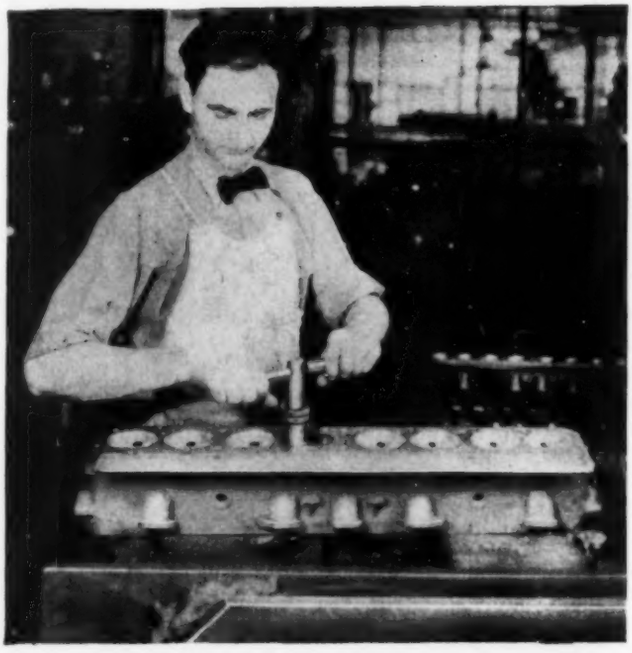


Fig. 2—Hand reaming the valve seat recess

at the top by which the head holds them in place. Multiple tools are used to reduce the turning time. The sleeves are then hardened to 75 to 80 scleroscope on the inside, the O.D. remaining soft on account of the carbon being removed.

Clamping the sleeve on the ends on the expanding mandrel of the usual type, the outside is rough ground to 0–0.001 in. in a Norton plain grinder. The bore is then rough ground in a Bryant, the O. D. semi-finished on the plain grinder and a relief ground in the center.

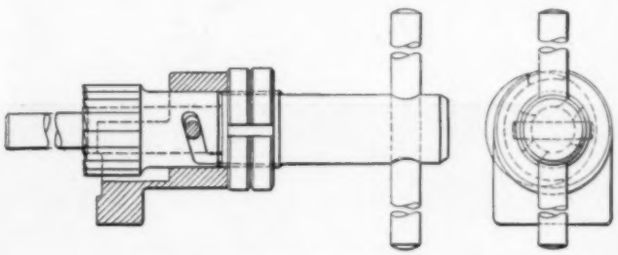


Fig. 3—Details of valve seat recess reamer

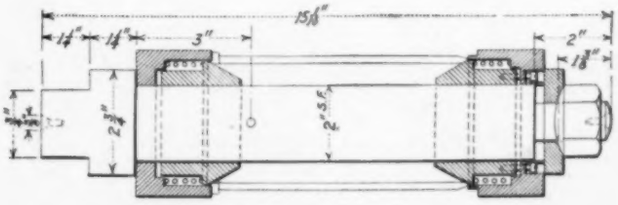


Fig. 4—End clamping mandrel for finish grinding sleeve

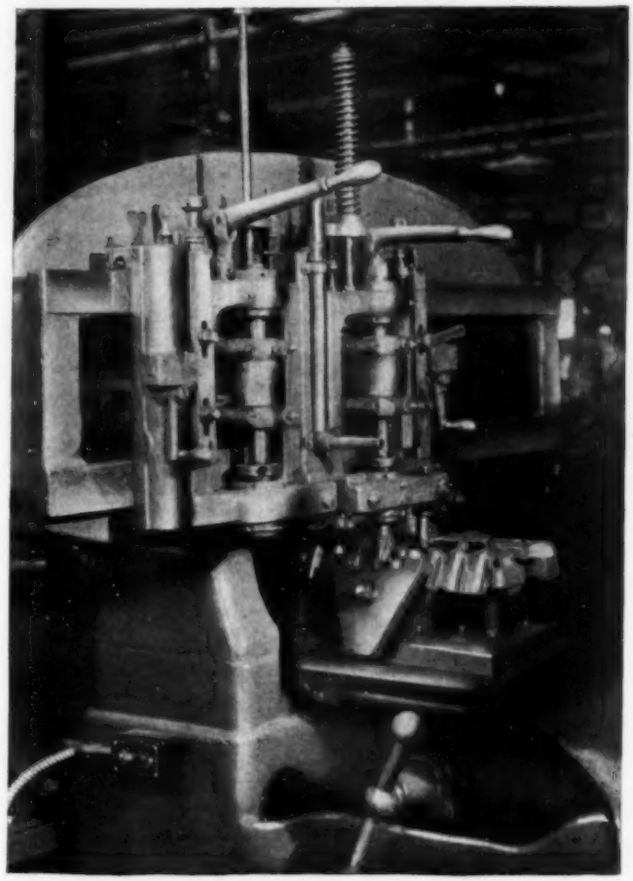


Fig. 5—Profiling the tappet guide

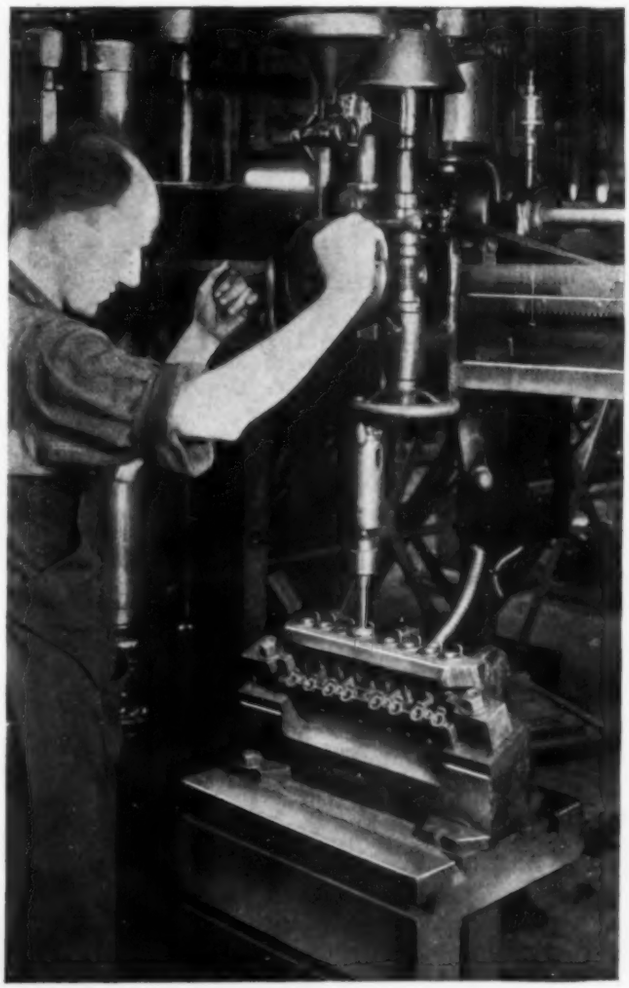


Fig. 6—Reaming the valve tappet guides

Then the flange is ground to ±0.001 in thickness, the sharp corner relieved and the other end chamfered in a Heald internal. Another Heald machine finish grinds the bore. It is then mounted on a special mandrel, Fig. 4. This mandrel has two, spring-mounted cones that center the sleeve, which is then clamped at each end as the nut is tightened. Next it goes back to the plain grinder to finish the O.D. The sleeves are carefully measured for both inside and outside diameters and are selected for just the right fit in the cylinder block. Pistons are also selected for the bore of the sleeves, the desired clearance requiring an 8-lb. pull on a 0.003-in. ribbon.

Tappet guides are a small but important part of a motor. This is particularly true when 32 valve tappets are to be considered. These tappet guides are made in groups of 16 which are interchangeable, and so require accurate work in machining. They are first milled on the face and then profiled on the machine in Fig. 5. The 8 holes in line are then drilled in a trunnion fixture in Fig. 6 which slides back under a second set of tools that rough reams the holes. Single hole reaming follows as in Fig. 6, after which oil grooves are cut in a sort of arbor press where a spiral slot guides the tool as it cuts the oil grooves.

Another hand reaming follows and the holes and bolting surfaces are tested for alignment. If the casting has gone out of shape the error is corrected by scraping before the guide goes to the assembly line.

The second of a series of articles on Marmon methods.

Optics in Metal Working

IV—The Optical Drill Gage

KEN G. NIBLACK
Bausch & Lomb Optical Company

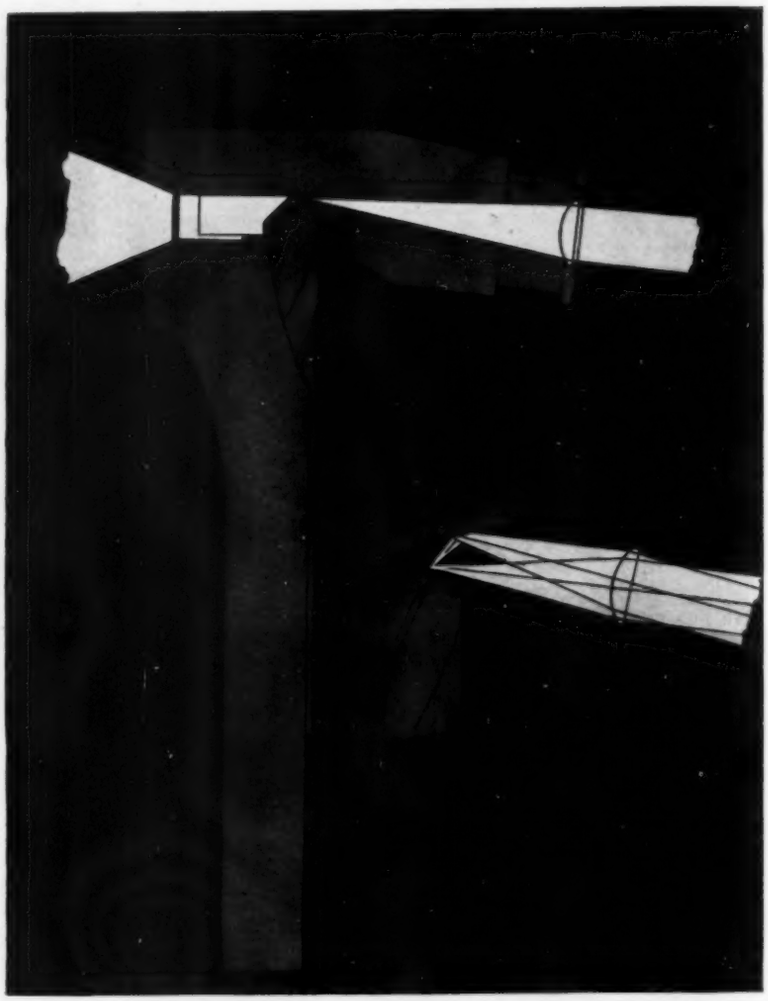


Fig. 1—The light enters at the back of the gage, passes around the drill and through the eye lens. Reflecting surfaces double any inaccuracy where the drill point does not make contact

THERE is a knack in doing almost everything, and grinding a twist drill properly is one of the early lessons learned by the embryo machinist. It is one of those things, like his ability to propel tobacco extract into remote out-of-the-way places, upon which he prides himself—a knack which distinguishes him.

The machinist holds his twist drill up to the window and revolves it, watching the point and the angle of the cutting lips; he pronounces his drill okay. Perhaps we should not disillusion him; but the fact remains that without a proper gage it is almost impossible for any man to judge the accuracy of a twist drill. There are too many factors that affect its cutting ability.

Three of these many factors should always be checked in order to get the best speed, the most accurate hole and the longest service between sharpenings with the least amount of strain to the drill press. This cannot be done accurately with the naked eye. The optical drill gage is equipped to make these three necessary tests. The operator has only to turn the drill in the gage in order to test the angle and symmetry of the cutting lips, the position of the web and the concentricity of the point. The lip clearance can be determined at the same time if angles of 12 and 15 deg. (specified by Cleveland Twist Drill Co., among others) are scribed on the V in which the drill is held. The two lines will determine the limits between which the lip clearance angle must fall. They can be scribed in a position that will accommodate all sizes of drills, that is, in the lower part of the field of the magnifier. The magnifier can be removed when observing the lip clearance of large drills.

The drill gage consists of a casting in which a V has been cut to hold the drill in alignment and on which are mounted hardened reflecting surfaces meeting at a 59-deg. angle. The contour of the drill point is observed through a magnifier, illumination being supplied through a frosted glass on the opposite side. When the drill point is observed against these reflecting surfaces any angular inaccuracy appears doubled and is also magnified several times by the eyepiece. Close inspection is thus possible.

A drill should be accurate. Both cutting lips should be symmetrical and of the correct angle to do their full share of the work. The point of the drill should be in the center if the drilling action is to be smooth, the hole cut to size and the highest rate of cutting achieved.

Speed alone is an item worthy of consideration, especially in multiple drilling where the time of the drilling operation is fixed by the time of the poorest drill. The poor drill is the weak link in the chain.

Fig. 2—In use, the drill gage is pointed toward a window or other light source

Results of Different Grinding Methods

Drill No.	Concentricity of Point, Inches	Angle of Cutting Edge	Size of Drill Inches	Size of Hole, Inches	Straightness of Hole, Inches Taper	Roundness of Hole, Inches
1—Ground on mach., perfect to gage	0.0005	118°	0.3122	0.314	0.0005	0.0005
2—Ground on hand, perfect to gage	0.0005	118°	0.312	0.315	0.0005	0.0005
3—Machine ground without gage	0.002	117°30′	0.3128	0.317	0.0015	0.0005
4—Machine ground without gage	0.0025	117°8′	0.3123	0.3153	0.002	0.0005
5—Hand ground without gage	0.007	115°48′	0.3128	0.319	0.003	0.0005
6—Hand ground without gage	0.003	111°53′	0.3127	0.318	0.003	0.005

Six $\frac{5}{16}$-in. drills were ground by different methods. No. 1 drill may be considered as best possible practice. Variations from the top row of figures, therefore, indicate the degrees of inaccuracies in the other drills.

In order to satisfy my personal curiosity I had some tests made with six new drills all of which were the same make and all $\frac{5}{16}$ in. in diameter. Two of these drills were ground on a standard drill-grinding machine, and two of them were ground by hand by men who were experienced in such work. The accuracy of the new drills was checked on the contour measuring projector. Then one drill was ground by the drill grinding machine, the operator correcting the machine until the drill came through perfect or very close to perfect when examined through the drill gage. Another drill was ground by hand and brought to a close accuracy by observing it with the drill gage.

These tests, which should prove interesting to a man who does very much drilling, were made in the Bausch & Lomb plant.

In a department where there was no mechanical drill grinder, the drill gage was not liked, since it was difficult to get a drill sufficiently accurate to look well in the drill gage. On the other hand in a department where a popular make of drill grinder was available the drill gage was well liked, for by using it the operator was able to make corrections and keep the drill grinder doing highly accurate work. It requires skill and patience to grind a drill accurate by hand. With the automatic drill grinder it is comparatively simple. A glance at the table will show the difference in the work done by the drills that were ground to the gage.

We compared the time required by drill No. 1 and drill No. 5 in going through a piece of $\frac{5}{8}$-in. steel. We timed the drilling of a half dozen holes with each drill and found that the average was two seconds longer for drill No. 5, 20 sec. as against 22 sec.; a 10 per cent difference.

The two upper illustrations in Fig. 3 show drill No. 1 and drill No. 5 respectively as they appeared after the drilling operation. They probably did not look very much different before, according to the figures on the chart. Notice in the illustration how the reflecting surfaces of the V gage at the end of the drill doubles the inaccuracy of an angle. This reflecting feature, combined with the magnifier, and illuminating arrangement is responsible for the high degree of accuracy that can be obtained.

Fourth of five articles.

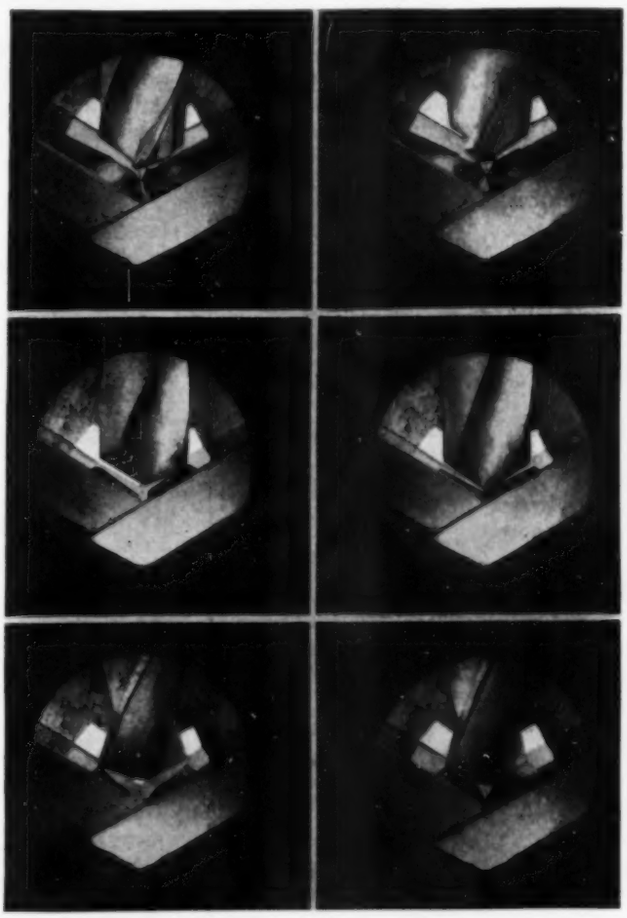


Fig. 3—A good drill on the left and a poor drill on the right. At the top the cutting lips are being tested, in the center the point, and at the bottom the position of the web are being checked

A simple change in flute angles gives free cutting, uniform sizing, and a burnished finish

A Worm Hob Design

NIKOLA TRBOJEVICH
Research Engineer,
Timken Detroit Axle Company

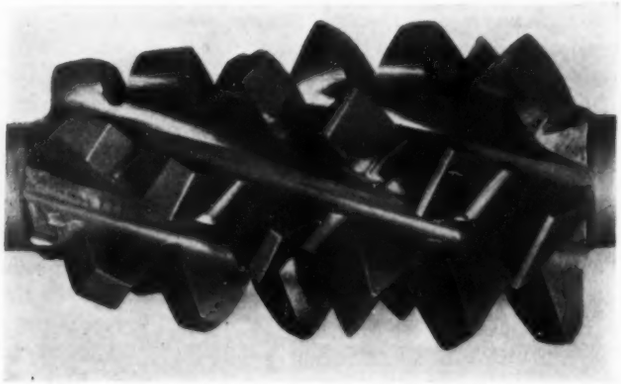


Fig. 1—The flutes are formed from two dissimilar helices causing them to become narrower at the large end of the hob

IN THE manufacture of worm gearing, the matter of accuracy and finish in both members (the worm and the wheel) is of prime importance, much more so than in other forms of gearing. Whereas in ordinary gearing, such as spur, helical, and bevel, continuity of the oil film under load cannot be attained because of the inherent discontinuities of the sliding surfaces. Worm gearing has no such discontinuities, making it theoretically possible to construct a unique type of gearing in which metal-to-metal contact is entirely eliminated.

From a practical point of view, this peculiarity of worm gearing is both a burden and an advantage to the manufacturer and the designer. It is, of course, burdensome to be compelled to work to extremely fine limits, to go to painstaking lengths in selecting and preparing the materials employed. On the other hand, once these formidable difficulties are surmounted, a gear of an unexcelled sweetness, quietness, long life, and load-bearing ability is obtained.

In the last few years, considerable progress was made in the manufacture and design of worm gearing of which the general public is not yet aware. The improvements center mainly upon the improved processes of hobbing the wheel and grinding the worm, although certain far-reaching discoveries were also made in the field of globoidal or hour-glass type worms.

The present article deals with the problem of a theoretically correct worm hob. Worm gears may be hobbed by two distinct methods—the infeed and the tangential feed. The first is a process of utmost simplicity in that the hob is merely fed into the work radially without any side motion whatever. In spite of this apparent advantage, experts strongly object to this method. Their reasons are first, that an unduly large percentage of the tool and machine errors are transferred to the work; second, only an incomplete envelope is produced; and third, there is no means of compensating for the loss of diameter and form of the cutter which occurs after each resharpening. Thus, for purposes of first-class workmanship, the infeed method may be considered as practically non-existent.

In the tangential method, the hob is fed along its axis in a direction tangential of the work, thus accomplishing a continuous and progressive formation of the tooth envelopes in the direction of travel, said envelopes being fully formed at any particular point of the gear at the instant the finishing cutters cross the surface of action. An inherent advantage of this method is that of the grade of finish may be accurately predetermined by properly adjusting the feed mechanism. That is, the finish may be made independent of the number of cutter teeth employed. Another quite as important an advantage is that the hob teeth now may be formed in a differentiated series, for example, they are not necessarily all of the same cross contour, thickness, rake or relief as in the infeed method.

Based upon this principle, the writer has constructed a hob in which the above mentioned differentiation may be accomplished simply and automatically in an ordinary back-off or relieving lathe. Such a hob exhibits the remarkable property, that although it cuts freely and without a drag, yet it does not change its tooth form, pitch diameter, helix angle and thickness of tooth after resharpening. Another advantage of this hob is that its form is readily corrected after hardening by means of cylindrical grinding alone. The relieved surfaces do not have to be ground in the threads by means of small pencil wheels as heretofore.

In the new hob (Figs. 1 to 4), the flutes are of novel

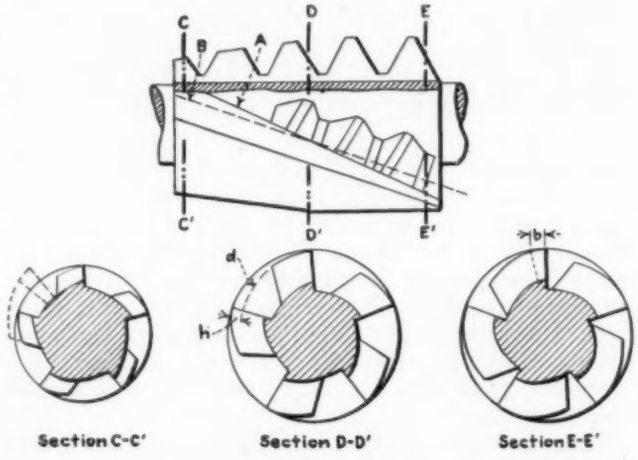


Fig. 2—The center section resembles the conventional hob but the teeth are cropped off at the small end and left wider at the large end

construction in that they consist of two superimposed systems, one of a shorter and one of a longer helical lead, thus producing flutes which are wider at the roughing or entering and narrower at the finishing end. The helix of the shorter lead, A in Fig. 2, is the one along which the hob is sharpened while the longer helix B is the helix along which the hob is backed off. The two helices intersect at section D–D' or about the middle part of the hob.

The employment of these two diverging helices brings out a surprising and interesting differentiation in the formation of the successive hob teeth in an automatically formed sequence. At the front end of the hob, the helix A is ahead of the helix B, which results in lopping off the front ends of faces of the cutting teeth as shown. In the neighborhood of section D–D', the teeth are substantially as in a standard finishing hob. At the large end, the cutting teeth possess an unrelieved portion b at their fronts, which is followed by a relieved portion at the rear end of each tooth.

As shown in the pitch plane development, Fig. 3, we first mill the required number of flutes B of the longer

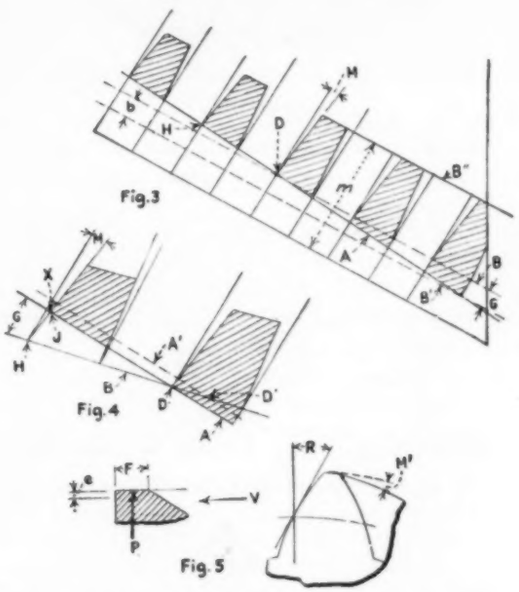


Fig. 3—When relieving the teeth, the tool starts along helix B, leaving portions of the teeth between helices A and B unrelieved. Fig. 4—Sharpening the hob does not alter the shape of the finishing tooth but merely moves the first full tooth axially toward the large end. Fig. 5—The metal removed by each burnishing tooth may be accurately controlled, thus avoiding any chance of excessive abrasion

lead thus leaving the parallel thread strips $B'B''$. The hob teeth are now backed off using the parallel helix B as the starting line, so that the portions of teeth lying between the helices B and B' will remain cylindrical, or non-relieved, while the portions lying outwardly from the helix B will be relieved. The distance b between the last two helices corresponds to the distance b in Fig. 2.

After thus partially backing off the hob teeth, we obtain the sought for differentiation by cutting across the front ends of the hob teeth with a helix A of the shorter lead, said helix forming an angle G with the helix B. The effect of this last operation will be to make each tooth in the hob different from every other tooth;

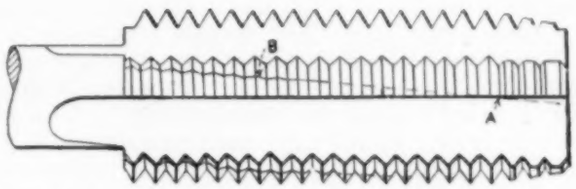


Fig. 6—The same principle may be applied to taps, combining the merits of the relieved and the unrelieved tap

however, all teeth taken together will form a graduated series, which is a matter of importance in this theory.

The introduction of the second helix A produces two important results; first, all teeth to the left of the point D, which is the intersection of the helices A and B, are of a decreasing thickness of tooth from the point D, while the teeth to the right of the point D are all of uniform thickness but all possess cylindrical bands of an increasing width. Thus, in a single operation, we have produced first, a series of roughing teeth of an ever-increasing width so that each tooth will take its proportional share of the work; second, a finishing tooth at the point D; and third, a series of burnishing teeth having burnishing surfaces arranged with increasing areas.

Still further, these conditions will not change after resharpening. Let us sharpen the hob along the helix A' parallel to the helix A, Fig. 4. The point of intersection D will now travel to the right in its new position D', but the hob will still have the roughing series, the finishing tooth, and the burnishing series, as formerly. By the time the point D reaches the end of the hob, the hob will be spent, but not until then. During that time, its cutting radius will remain unchanged, and the manufactured worm gears will all be exactly alike.

We shall now explain the cutting action of a non-relieved or burnishing tooth and show that to prevent the said tooth from burning up or becoming abraded by excessive friction, it is sufficient and necessary that the above mentioned roughing series, leading up to and connecting with the said burnishing series, should do so without forming too great an interval or a gap. The practical means of doing this is the most valuable part of this invention.

As diagrammatically shown in Fig. 5, the non-relieved tooth should take a chip of a thickness e from the work piece. Let the contacting area of the tooth be denoted by F and the cutting velocity by V. Then the force P with which the tooth has to be pressed against the work to produce the deformation e will be:

$$P = k_1 F e^k \qquad (1)$$

and the developed heat per second W will be:

$$W = k_2 P f v \qquad (2)$$

where the letters k denote constants and f the coefficient of friction.

Observe that the highly injurious force P will be generated at an amazing rate as soon as the jump e exceeds a small limit, maybe less than 0.001 in. However, for the values of e less than that, the tool will pass through the work freely, much as though it were relieved. This action may be explained first, by the structure of Equation 1 (in which the exponent k is always greater than one), and second, that by exceeding a certain force P the oil is squeezed from between the moving parts of the hobbing machine thus establishing a rigid metal to metal contact. Therefore, it is imperative to keep the

force P within bounds, and that is most effectively done by reducing the jump e and the area F.

The angle G, included between the helices A and B, Figs. 3 and 4, may be calculated to produce a jump e not to exceed a certain predetermined limit. When a hob tooth is backed off in a lathe, the motion of the back-off tool combined with the rotation of the hob generates an Archimedean spiral having a drop h from tooth to tooth, Fig. 2. The tool meanwhile moves parallel to the hob axis thus producing actually a resultant composed of an Archimedean spiral and a straight line, that is, a conical helix.

The clearance angle M' at the top of the hob tooth (Fig. 5) may be determined from the equation:

$$\tan M' = \frac{h}{m} \qquad (3)$$

where m is the shortest distance (in development) from tooth to tooth as indicated in Fig. 3.

Let R now be the normal pressure angle of the hob tooth (Fig. 5) and M be the side clearance angle of the said tooth on the pitch line, (Figs. 3 and 5). Then:

$$\tan M = \tan M' \tan R \qquad (4)$$

The side clearance angle M will usually be from three to four degrees in a coarse pitch, high helix-angle hob.

We shall now calculate the distance x, Fig. 4 to determine by how much the roughing tooth will be undersize for a distance HD equal to the distance from tooth to tooth as measured along the helix B.

$$x = HJ \tan M \qquad (5)$$

but

$$HJ = HD \tan G \qquad (6)$$

Now, the thickness of the chip c, Fig. 5, will be equal to:

$$c = \frac{x}{N} \qquad (7)$$

where N denotes the number of flutes.

It may now be seen that the thickness of the chip c (the maximum which the first burnishing tooth will be required to take) may be controlled by selecting properly the dimensions found in Equations 3 to 6. In particular, the whole procedure hinges mostly upon the proper selection of the divergence angle G. I have found in practical work that the angle G should be around 4 to 5 deg., the angle M' about 6 to 7 degrees, this gives a burnishing chip between 0.0007 and 0.001 in. thick.

Regarding the manufacture of these hobs, it may be noted that by one process the flutes B of the longer lead may be milled first, then the hob is backed off and the flutes A are milled afterwards, and by another process, both systems of flutes are milled one after the other and the hob is backed off afterwards. The hob is then hardened, sharpened, and the cylindrical lands are ground usually in the same machine and set-up in which the worms (of which the hob is a counterpart) are ground, thus insuring a perfect duplication of tooth contours. The pitch diameter of the hob may be made exactly the same as that of the worm or 0.001 in. larger.

As is seen in the photograph Fig. 1, in which the cylindrical thread surfaces appear as bright white areas (because they are ground over), these surfaces are of a more or less irregular shape indicating the uneven distribution of deformations incurred in hardening. Yet such a hob will produce accurate work because the protuberances which undoubtedly have occurred during hardening are uniformly ground off in the final operation and are thus rendered harmless. In this system, it may happen that a certain hob tooth at the same time will be roughing, finishing or burnishing at its various portions depending on the amount of distortion which occurred during heating and quenching.

Upon this differential principle, taps of unique cutting characteristics have also been constructed. In Fig. 6, the triangular area formed by the cutting face A and the back off helix B is non-relieved while the remainder of the thread is relieved. A tap of this kind cuts smoother and vibrates less than a tap of either the wholly relieved or a wholly unrelieved type.

In Fig. 7 a cutter for generating globoid worms (such as are used in steering gears of automobiles) is shown. A tangential feed is employed, and the non-relieved or only slightly relieved areas ream out the worm in the same machine and operation in which it is roughed out and finished.

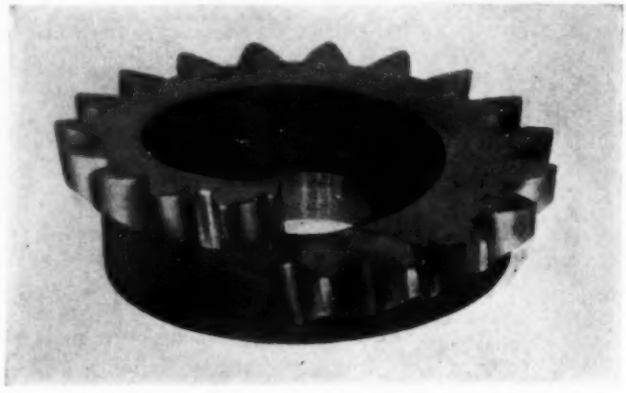


Fig. 7 — Hour-glass steering worms are roughed, finished, and reamed in one operation with this cutter

20,000 a Year from Waste Heat in the Forge Shop—*Discussion*

HARRY SHAW
Shaw & Son, Heywood, England

The interesting item outlining the utilization of waste heat in the Kropp Forge Plant in Chicago (*AM*—Vol. 74, page 424) reminds me of an anecdote told many years ago at Johannesburg before the Chemical and Metallurgical Society of South Africa in 1911. In relating the incidents of a visit to a large iron and steel works at Ilsede in Hanover, Germany, a speaker made this remark:

"The last little point, although one perhaps of a sentimental nature, but one which all of them were struck with was the wonderful garden colonies that all the workmen had there. Every garden contained those luxuriant growths that one would expect to find only at the tropics. The explanation was this: With the blast furnaces there was a vast amount of waste heat available, and it occurred to the manager that some of it might be utilized beneficially, so he trapped a lot of the waste heat, hot gases and steam, using these to heat the waters of a canal over which he built an enormous green-house. There a gardner was kept, year in and year out, to produce various plants and particularly vegetables, which were distributed free to all employees."

Ideas from PRACTICAL MEN

Checking the Angle of Helical Gear Teeth
Discussion

U. SETH EBERHARDT
Works Manager, Newark Gear Cutting Machine Company

We have been following the discussion on the above question, and we feel Francis W. Shaw has given a very good criticism (*AM*—Vol. 75, page 27). We are checking helical gears every day to find the angle or lead in order to make a new gear or a mate from a sample. For years, we used the method described sometime ago, of rolling the gear on a piece of paper along a straight edge, thus getting the O.D. angle. We are now using a method which we have found quick and accurate.

In measuring a gear, we hold a square on the side of the gear having the blade parallel with the axis. Then, we measure carefully the distance from one tooth to another along the axis. If more than one tooth overlaps we measure two or three teeth. This makes the measurement more accurate. By multiplying the distance from one tooth to the next parallel with the axis by the number of teeth in the gear being measured, we get the complete lead.

If a pinion is cut solid on a shaft then we lay the pinion on a surface plate with a scale alongside. We always check the lead while cutting, and we have found since using the method just described, 90 per cent of the jobs are right on the first trial.

GEORGE BELBES

Complying with the request of Francis W. Shaw (*A.M.*—Vol. 75, page 27) for further information regarding the device for checking the angles of helical gear teeth described by me (*A.M.*—Vol. 74, page 553), I wish to offer the following additional explanation:

If the rod of the two-ball device is made large enough, so that when placed between two teeth of a helical gear, it does not sink below the upper surface of the gear teeth, and small enough so that it does not rest on the edges of the teeth, such a rod should prove satisfactory. The best results will be obtained, however, if the rod is so made that the points of tangency on the two teeth will subtend an angle of 90 deg. with the center of the rod. This can be reduced to the following formula:

$$D = \frac{T}{\cos 45^\circ} = \frac{T}{0.707} \qquad (1)$$

where D = the diameter of the rod and T = the thickness of the tooth at the pitch line. It will also be found that this formula corresponds closely to:

$$D = \frac{1.6\ S}{\cos 45^\circ} = \frac{1.6\ S}{0.707} = 2.26\ S \qquad (2)$$

where S = the addendum of gear to be checked. The most suitable diameter of rod may, therefore, be determined by either of these formulas.

Although it may be desirable that the rod lay along the pitch line of two adjacent teeth, it is not essential that it do so; it is only necessary that it be arranged so that it will follow the direction of the teeth. It is obvious, of course, that a straight line or a set of straight lines cannot coincide with a helix or a set of corresponding helices, but that is not a prerequisite. For if the rod contacts at two points near the beginning of the teeth and two points at the opposite end of the teeth, these points will determine a pair of straight lines inclined to the axis of the gear at an angle corresponding to the helix angle.

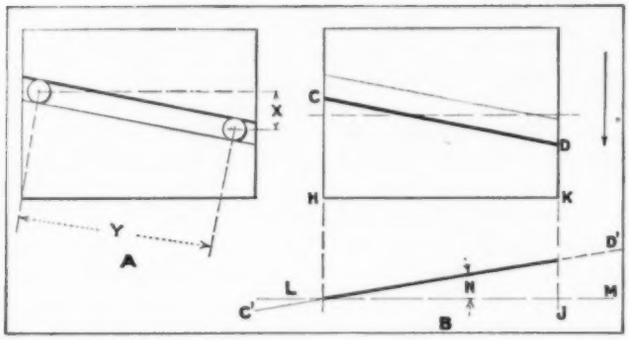
With reference to the difficulties experienced by Mr. Shaw in balancing the rod, I am inclined to think that he was attempting to check a worm gear or a gear of short lead for which the device is unsuitable. It will be found, however, that if a gear has an appreciable lead, no balancing is necessary, the device being clamped between two teeth and the two spheres of the device brought in alignment.

In reply to the questions A, B, and C, I wish to state that by means of a height gage or a similar indicating instrument, it is a comparatively easy matter properly to locate and align the rod so that the center of the helical tooth-space will lie in the same vertical plane as the axis of the gear. If this set-up is arranged on blocks or on an angle plate, the whole can be rotated at right angles to the original position and the helix angle can then be checked accurately.

In conclusion, the writer wishes to inform Mr. Shaw that several toolmakers have made sets of this device, covering a wide range of gear pitches, which are being used successfully, a fact which further substantiates the practicability and adaptability of the tool in question.

CHARLES KUGLER

In an article under the title given above (*A.M.*—Vol. 75, page 27,) Francis Shaw tells his experience in trying the method of checking the angle of helical gear teeth described by George Belbes (Vol. 74, page 553.) I have also tried this method and have found the same difficulties as those experienced by Mr. Shaw. In finding the helix angles of gears and milling cutters many



years ago, I used the method indicated at *A* in the illustration. Two balls having a diameter large enough to determine the distance *X* were placed in a tooth space, one near each edge of the gear, being held by a drop of solder. The dimensions *X* and *Y* were obtained by the use of an indicator and a height gage. From the proportions of these dimensions, the helix angle was easily calculated.

The only difference between this method and the one described by Mr. Belbes is that he had the balls on the end of a rod that was laid in a tooth space, while I placed the balls directly in a tooth space. I was never able to get satisfactory results from this method; just why I do not know. Perhaps it was because the tooth has a twisted surface.

I now use the graphical method indicated at *B*. The gear is stood up on its face on a piece of drawing paper and a lead pencil is rubbed on the top of one of the teeth, as indicated by the line *C-D*. When the gear is rolled in the direction of the arrow, bringing the marked tooth down in contact with the paper, the graphite deposited on it by the lead pencil will leave its mark on the paper, as shown by the line *C'-D'*. If the side of the gear is kept against a T-square when rolling it, the parallel lines *E-H* and *J-K* can be readily drawn. The line *L-M* can then be drawn at right angles to the lines *E-H* and *J-K*, and the angle *N*, thus formed, can be determined by a protractor.

No claim is made that accurate results can be obtained by this method, but it is the best that I know of. If any readers know of a better method, I will be glad to hear from them.

Sometimes the mechanic is handed a worn-out helical gear, or milling cutter and is told to make one just like it when it was new. In such cases, it is evident that the mechanic must make his own calculations.

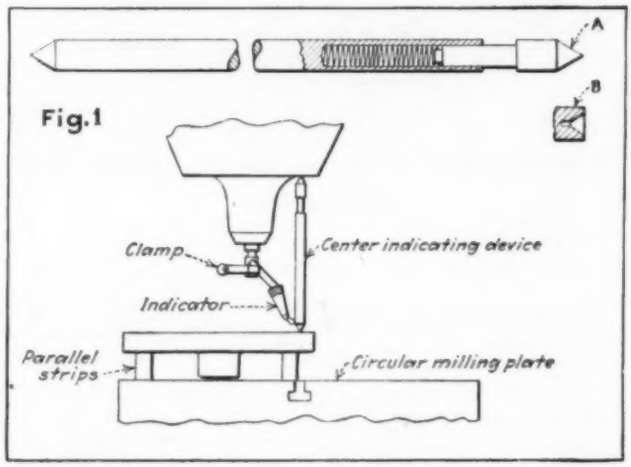
Machining Cam Arcs

PHILIP F. SHAFRAN

In machining cams such as the one shown in Fig. 2, particularly when one or two only are required, the method usually followed is to lay out the groove outlines, mill to the lines as carefully as possible, and finish by touching up with a file. While this method may prove satisfactory for many classes of work, the accuracy of the results depends entirely too much upon the skill of the operator.

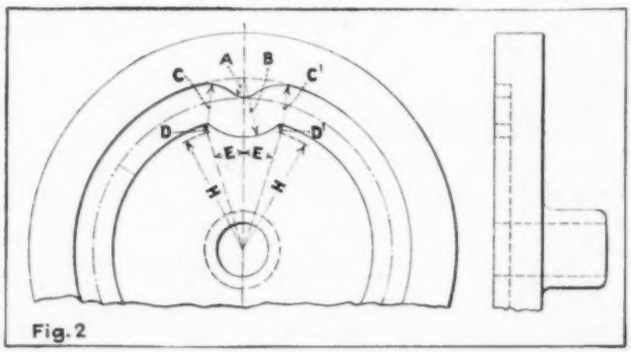
The following describes a somewhat different method used in machining two such cams: Starting with a finished blank, that part of the groove that clears the lobe at radius *A* was cut in the lathe, the work being held on a mandrel. The blank was then mounted on a dividing head and the centers for the radii *A*, *B*, *C*, *D*, *C'* and *D'* were laid out carefully, using the dividing head to locate the angles *E*, and a height gage for the distance from the center *H*. The centers were then very carefully prick punched and the radii were scribed on the blank. The blank was then set up on a circular milling table so as to be concentric with the turned groove, using a test indicator. The rest of the groove concentric with the shaft hole was milled with an end mill held vertically. The common center for the cam arcs *A* and *B* was then centered accurately with the center of the circular table, the method indicated in Fig. 1 being used.

The center indicating device shown in the upper part of the illustration is a modification of a type that is familiar to toolmakers. The conventional type has, instead of a pointed end at *A*, a cupped center, as shown at



B, and is used to true up a center-punch mark on work usually on the faceplate of a lathe, the cupped center being held on the tailstock center. The point makes it possible to anchor the upper end to the housing of the vertical milling head, or if desired, to the center of the end mill.

If the point *A* tends to slip on the housing, a small center-punch mark will hold it in position. The centers



are located by revolving the table and shifting the blank until the needle of the indicator shows no motion. The radii *A* and *B* are then milled and the space between them is checked with a plug gage of the same diameter as that of the cam roller. The radii *C* and *D*, and *C'* and *D'* are then milled in the same manner. This method produced a clean-cut, smooth job having accurate arcs.

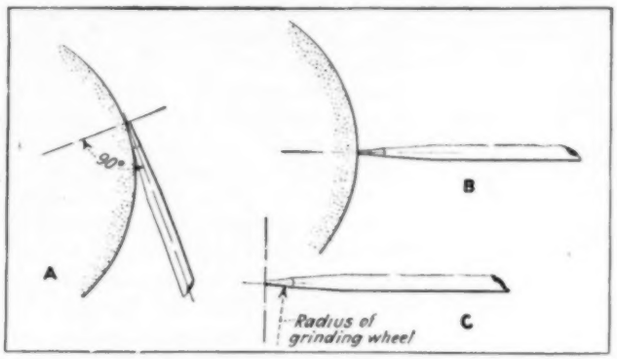
This same method can be employed on any cams where true arcs are to be machined. It can also be used on plate cams, and is an excellent method for machining master cams.

Grinding Screwdrivers Correctly

JOHN E. ORBAN

Whenever I have had occasion to borrow a screwdriver, I have found that in nine cases out of ten it has been ground in such a way as to permit it to slip and mar, or injure, the slot in the head of the screw.

The correct way to grind a screwdriver is to hold it against the wheel as shown at *A* in the illustration.



The point should be ground equally on both sides to the proper thickness to fit the screw slot. Then the point should be squared by holding it against the face of the wheel, as indicated at *B*. The final shape should be as shown at *C*. Of course, it is necessary that the grinding wheel be sharp and run true.

A screwdriver ground in the manner described will rarely need regrinding. Incidentally, very little endwise pressure is required to prevent the point from slipping out of the slot, even when the screw is a tight fit.

An Inverted Punch and Die—*Discussion*

CARL E. SCHINMAN
Mechanical Products Manufacturing Company

In an article under the title given above (*AM*—Vol 74, page 914), Charles H. Willey describes an inverted punch and die, and asks how others would handle the job the tools described were intended for. Since the sketch of the part made carries no dimensions, it is not possible for me to state definitely how I would handle the job.

Assuming, however, that it was not possible to produce the part without the use of overhanging tools, it is my opinion that it could have been produced without resorting to tools that forced the slug to the top. Such tools are complicated in both design and operation. In cases where it was neither practical or possible to have the slugs drop through the bolster, I have used sloping openings in the die-shoes, starting under the dies and running to the sides of the shoes. Such openings may be either cored or machined.

One such die was used for punching square holes in ventilator sheets. Four holes were punched at a time, the work being done in a large forming press that did not permit slug ejection through the bolster. This die was made more than a year ago and no report of trouble has ever been received.

SEEN AND HEARD

JOHN R. GODFREY

Control in Die Casting

AT THE PLANT of the Newton Die Casting Corporation the casting of aluminum-base alloys is kept on a separate floor from that of the zinc-base alloys in order to avoid even a slight mixing of metals that would "contaminate" the alloys. According to Fred J. Tobias, research engineer of the company, it has been found by actual test that a contamination of 0.005 per cent in the zinc may reduce the tensile strength of the casting as much as 10,000 lb. per sq.in. Virgin zinc of 99.99 per cent purity is being used. Control of casting temperature is also highly important, and every furnace has pyrometer control with red, green and white signal lights.

Obsolescence

OBSOLESCENCE is an elusive bird. Some have the idea that it is a matter of age or physical condition of machines. Neither is true. There are cases where new machines have been found obsolete before they were put into opration. A machine or a method becomes obsolete as soon as something better is developed.

Fire in Magnesium Chips

FLASHLIGHT powder does not seem exactly the sort of stuff to use in making parts for airplane engines, but we are using more and more magnesium because of its lightness and strength. Of course it isn't in powder form, and it doesn't "go off" while it is in a solid casting. Magnesium chips do occasionally take fire, however, either from tool friction or carelessness with matches or other flames. And when it does, don't go for the fire extinguisher, that only makes it worse. Use powdered or ground asbestos that blankets the fire and smothers the flame.

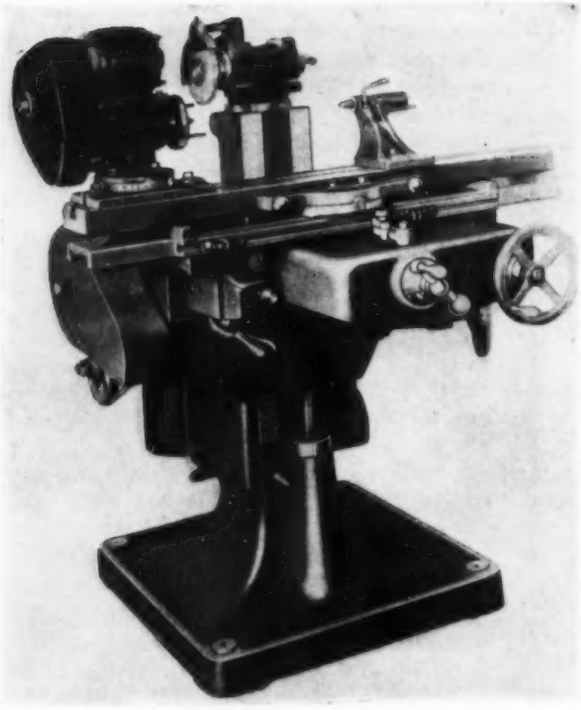
Seven Months Between Grinds

WHEN you think of tungsten or tantalum carbide by the pound, it seems to belong in the luxury class along with three-carat diamonds and matched pearls. But when a boring-mill operation shows you tools tipped with the new cutting alloys that have not been taken out of the machine for seven months and are still on the job, the price per pound gets lost in the shuffle. True this was an aluminum alloy job, but even so there is a nice saving in the use of the high-priced tools.

Automatic Center Punches and Mailing Lists

ADAPTABILITY, as we have frequently remarked, is a valuable quality and one that leads to improvements in many lines. A recent example is the use of an automatic center punch, plus a suitable die on the end, to change expiration dates on mailing stencils. It saves time, delay and misfiling of stencils.

SHOP EQUIPMENT NEWS



Covel No. 91 Universal Cutter and Tool Grinder

Anti-friction bearings, heavy rigid ribbed castings, sensitive feeds, a wide selection of speeds, permanent accuracy, and protection from abrasive dust are incorporated in the Covel No. 91 universal cutter and tool grinder announced by the Covel Mfg. Co., Benton Harbor, Mich.

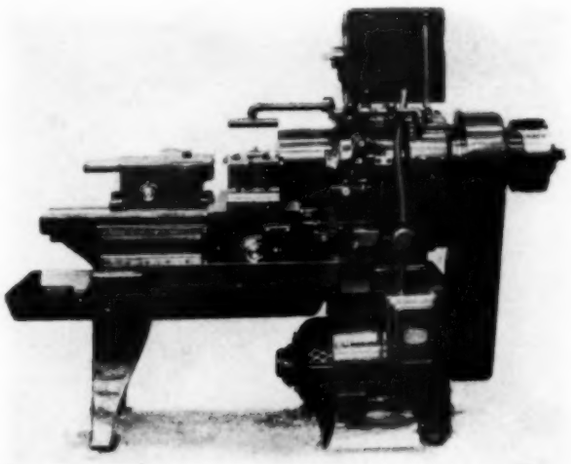
The column and base of the machine is a one-piece casting. The 6¼-in. wide by 29½-in. long vertical ways are cast integral with the column, and their ends do not enter the knee at either the extreme upper or lower position. The spindle runs in precision type, pre-loaded ball bearings. The spindle-head is a one-piece casting mounted on the top of the column with a stub 5 in. in diameter and 1¾ in. long a part of the casting. This stub fits down inside the column against a shoulder, and is locked in place by means of a double wedge. The spindle-head is graduated in degrees with the zero reading to the front. It will swing 110 deg. either to the right or left, so that any kind of cup wheel grinding can be done on either end of the spindle, as well as periphery grinding. Flat pads are machined on the top of the spindle-head for the purpose of clamping tooth rests and feed fingers. A pad on either side of the column for the same purpose is incorporated. The table and sub-table are of heavy ribbed construction, supported with saddle bearings. The table proper is supported by the sub-table with a large bearing in the center and one at either end. The main table pivots in the center on the sub-table, and is locked in place by two heavy screws on the front side. One end of the table is graduated in taper per foot. The center and front of the table is graduated in degrees and will swing in either direction 180 deg. A sensitive adjustment for this movement is provided by two large knurled screws on the front of the table. The main table has a central T-slot and all attachments are made to fit. Table bearings are 28¼ in. long, and are protected from dust by means of a tongue and groove construction with shields at either end.

A ball-bearing countershaft in the base is driven by a ¾-hp. motor mounted on the back by means of a V-belt drive. The pulleys are step-cone type, and to change the spindle speed, the guard is removed by taking off a large handnut in the center. The spindle has three speeds, 3,200, 4,500 and 5,800 r.p.m., and is driven from the ball-bearing countershaft also by means of a V-belt drive inside the machine with all belts completely inclosed. Take-up for belt slack is accomplished by means of the sliding plate into which the ball-bearing countershaft is mounted. The apron, 4 in. wide all around the saddle, is ⅝ in. thick and is curved down in front where two heavy ribs are cast on each side of the cross-feed screw bearing to assure sensitive and accurate feed, very necessary in cylindrical or internal grinding. The cross-feed screw, 1⅛ in. in diameter with ten threads to the inch, is operated by a ball crank on the front. Setting is done by a floating dial just behind the ball crank. The elevating handwheel is 8⅛ in. in diameter and is graduated in 0.0005 in. Graduations are $\frac{5}{32}$ in. apart on the wheel. The handle is conveniently located and can be operated from either the front or side of the unit. The elevating screw is mounted on ball thrust bearings and is 1½ in. diameter, five thread per inch. Longitudinal movement of the table is 20 in., operated by either the

large handwheel at the front of the saddle or a lever handle at the rear. The power table feed mechanism is powered by a ¼-hp. enclosed motor, driving the gear box through V-belts. All pulleys and belts are covered. The reverse clutch and gears run in oil and are protected against abrasive dust and foreign matter. Power is transmitted from the gear box to the table by means of a rack and pinion gear. Two table speeds are provided through a lever change. For a further speed change, an extra pulley is furnished with each machine, which can be changed by removing the large nut below the belt guard. With this combination it is possible to have eight table speeds. The automatic reverse movement, adjustable for length by means of reverse dogs that fasten in the T-slot on the front of the sub-table, will actuate as short as 2½ in. It can also be reversed by hand. The machine is also offered as a hand feed at a lower cost. A wide variety of attachments are furnished and certain special attachments are available as extras.

Specifications are: Longitudinal table movement, 20 in.; vertical table movement, 11 in.; transverse table movement, 8 in.; centers swing work up to 10⅜x28 in. long; working surface of table 5½x40 in. long; height center of spindle to floor, 48 in.; size of base, 30 in. sq.; 8 table speeds, 18 to 96 in.; main spindle motor ¾-hp.; power feed motor, ¼-hp.; headstock motor, ⅛-hp.; net weight, hand feed, plain with attachments—crated, 1,600 lb.; boxed, 1,900 lb.—70 cu.ft.

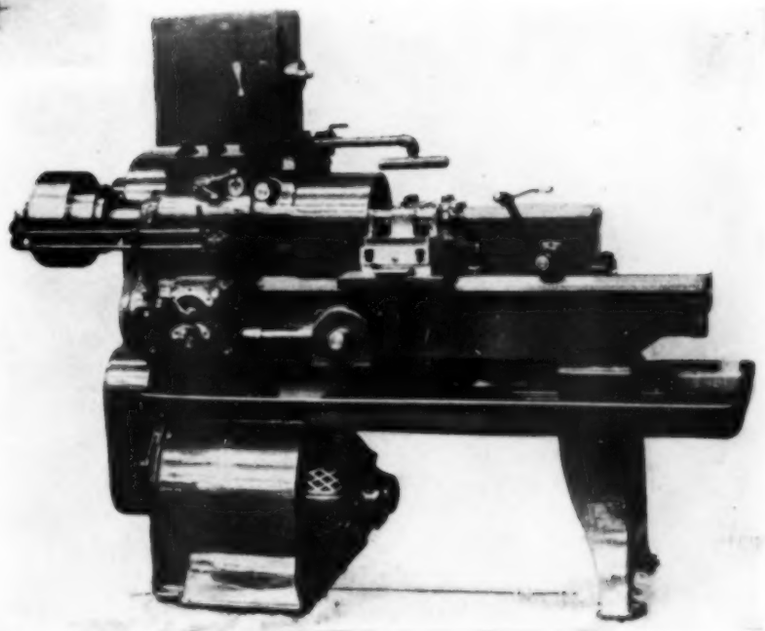
LeBlond Automatic Lathe for Facing and Forming



Believing that no single automatic machine can be developed for best results on all classes of work, engineers of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, have developed a special automatic lathe for rough and finish facing or rough and finish forming operations. The machine was designed to meet the demand for a simple automatic lathe and is so constructed that precision facing and forming can be produced at a maximum rate with a minimum of effort. The machine illustrated is tooled for rough and finish forming ball joints on the lower end of an automobile transmission shifter lever.

The feed mechanism for the machine is simple. However, it is so constructed that a wide variation of feeds may be instantly obtained by merely shifting two feed change levers. Feed is transmitted from the feed box through the shaft to the bevel gear drive shaft, which in turn drives the cam drum mounted on rigidly supported bronze bearings in an oil-tight case. The reduction ratio from the feed shaft to the cam drum is ten to one, giving a powerful drive free from torsional vibration under heavy cuts. The cam acts directly on a roller mounted on the lower side of the cross-slide. This construction not only simplifies the machine but eliminates the lost motion and resulting inaccuracy incurred where a link mechanism is used. The fact that the cam drum runs in a bath of oil lessens wear on cams and roller, thus appreciably increasing the life and accuracy.

The machine is entirely automatic in its cycle of operations, the only duties of the operator being to load, unload and press the spindle start lever. The tool slide is automatically traversed to the cutting position for the rough-forming tools. The rough-forming cut is then taken at a suitable feed and the tool slide is traversed to the cutting position for the finish form tools. At this point, a cam mounted on the end of the cam drum actuates a switch which shunts out part of the resistance in the shunt field circuit of the driving motor and thus reduces the spindle speed. The machine then feeds to the cutting position and takes a light finish-forming cut at a very reduced cutting speed, thus greatly increasing the tool life without reducing the production of the machine since the finishing cut is very short. When the cut is complete, another cam causes the shunt across the resistance in the shunt field circuit to be cut out and the spindle speed returns to the normal rate. The tool slide is traversed to the loading position, and the spindle trip dog on



the cam drum automatically stops the spindle and the coolant flow. This machine has a six-speed Timken-equipped geared head and spindle speeds up to 1,000 r.p.m. It is equipped with a special lever-operated quick-acting cutaway tailstock, designed to locate the work and to facilitate loading. However, a barrel-type tailstock can be furnished, either lever or screw operated, depending on the work to be machined.

Production on the gear shift lever is 50 parts per hr. Other work for a machine of this type would be rough and finish grooving pistons, forming ball crank handles and numerous small facing and forming jobs.

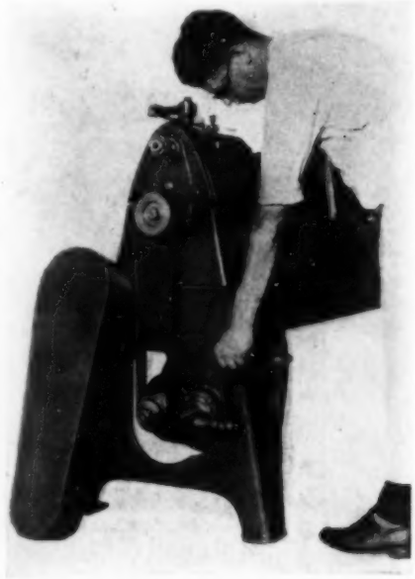
Sundstrand No. 56 D.E. Drilling and Centering Machine

To meet the demand for a more substantial, powerful and rigid centering equipment, the Sundstrand Machine Tool Co., Rockford, Ill., has produced the No. 56 D.E. drilling and centering machine. The tool is more than a centering machine, since reaming, spot facing and tapping operations can be performed equally as efficiently, especially where two ends of a part can be machined simultaneously. The right-hand head and both vises are adjustable longitudinally along the bed. Spindles can be operated simultaneously or independently. The vises can be operated independently by means of handwheels, or by special arrangement both vises may be operated in unison through one handwheel. Pneumatic-operated vises can be furnished if desired.

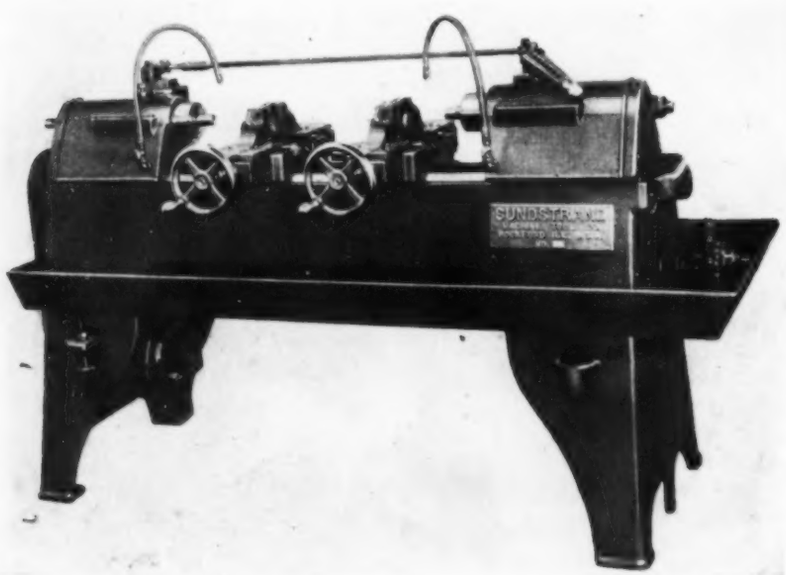
Spindles are of forged high-carbon steel, heat-treated and ground, mounted in Timken precision bearings front and rear with suitable provisions for thrust and adjustment. Oil pockets between bearings insure a liberal supply of lubricant. A $\frac{1}{32}$-in. hole is drilled through the spindle to accommodate suitable drawrods. Stop nuts are provided for accurately controlling depth of center drills or tools. The spindle is driven by wide-faced spur gears with Micarta idler gears to insure silent operation. Quill-type mounting is provided for the spindle. The quill is of semi-steel accurately ground and fitted to the drill head. Quills are actuated by means of a rack and pinion providing a 4-in. independent movement or a $1\frac{3}{4}$-in. simultaneous movement. Spindle heads are of rigid construction accurately scraped to the V's of the machine bed. The right-hand adjustable head is securely clamped in operating position by means of clamping screws located in an accessible position.

Vises have large bearing surfaces on the bed of the machine. The vise screws are generously proportioned and bronze nuts $2\frac{1}{2}$ in. long are provided with ball thrust bearings. Jaw inserts are hardened steel. Jaws may be offset for camshafts and other pieces of irregular shape.

The bed is of pyramid design, assuring rigidity and making for pleasing appearance; it has double channel construction with heavy cross ribbing assuring absolute elimination of warpage and deflection. A ten-gallon coolant tank is contained in the right-hand machine leg. A five-gallon per min. coolant pump is mounted on the leg directly over the oil pan, and is driven by means of a belt from the main driveshaft. The motor is mounted in the left-hand leg and V-belt drive is regularly furnished. Suitable provisions are provided for belt takeup, and guards are supplied as regular equipment. 1 to 5-hp., 900 to 1,800-r.p.m. motors are recommended. A combination of four quick-change speeds ranging from 85 to 1,800 r.p.m. can be provided by the adoption of a Westinghouse-Wise multi-speed drive.



Changing the speed with a Westinghouse-Wise transmission



Machine capacity is two 1-in. drills in steel. Work diameter is 6 in., either round or hexagonal. Length, up to 72 in., depending upon machine size. Speeds, 85 to 1,800 r.p.m., depending upon motor application. 1 to 5 hp., 900 to 1,800 r.p.m. motor recommended.

Specifications: Width of bed, 11

in.; distance top of bed to center of spindle, 6 in.; independent movement of spindles, 4 in., simultaneous movement of spindles, 1¾ in.; diameter of spindles in bearings, 1½ in.; diameter of spindle quill, 4 in.; spindle nose arranged for No. 3 Morse taper or for No. 3 or No. 20 Jacobs Chuck.

Natco Model D-5 Multiple Drilling and Tapping Machine

A new Natco multiple driller and tapper has been announced by The National Automatic Tool Co., Richmond, Ind., known as the Model D-5. It has been designed as a universal machine with a wide range of adjustments enabling it to handle work of varying sizes. It is built as a driller only, as a tapper only, or as a combination driller and tapper. The most economical tool speeds are secured through the use of spindle speed change gears. The machine has a capacity of ten ¼-in. drills or ten $\frac{3}{16}$-in. taps in mild steel.

The head has a drilling area of 5½x10 in. and is built to receive ten spindles. Provisions have been made to omit any that are not necessary. The spindles are held in place by an adjustable arm bolted to the underside of the head flange. A vertical adjustment of 1¾ in. is provided on all spindles to compensate for drill grinding. With the exception of the upper spindle bearings, all gears are mounted in Timken roller bearings. Upper spindles are of bronze, accurately machined to insure interchangeability. All gears are of hardened alloy steel, packed in grease.

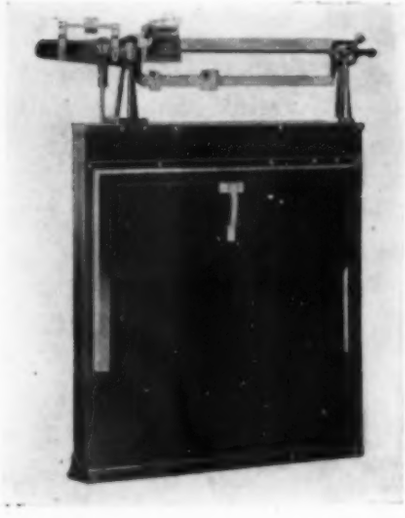
The standard spindles are reamed and threaded to receive the company's collets for straight-shank drills and taps. When taps of different pitch are used, it is necessary to provide a float in the spindle. When taps are of equal pitch, a standard drilling spindle may be used on tapping operations.

The column of the machine is of box form construction. Electrical equipment and wiring are within it. The arm-type limit switch controls the point of tap reversals and insures exact depths on blind-hole tapping. The switch is mounted on the adjustable arm and can be moved about to locate the trip mechanism as close as possible to the tap. The table is mounted on a sliding stem or post carried in an adjustable knee. The table stem is connected through rack and pinion to a feed level which extends downward to the right side for foot feed. The table is surrounded by a coolant channel which drains into a reservoir in the base. Correct spindle speeds are secured by transposing pick-off gears in the top of the head, making it possible to bring work with varying drill and tap sizes to the unit. High- and low-speed upper joint assemblies are standard equipment and can be furnished as required. Individual spindle speed changes are made by means of a slip bushing construction consisting of the upper joint bearing and the gear assembly. This can easily be made while the spindle arms are removed for set-up purposes.

The machine is furnished with or without a coolant system, including a motor-driven centrifugal pump mounted in the base at the rear. If desired, a toggle switch to control the motor can be furnished. The 1-hp. motor is capable of 50 reversals or 25 complete working cycles per minute. The 2-hp. motor is capable of 30 reversals or 15 complete working cycles per minute. Feed is applied through a float-operated lever to a table on which the work is placed. This method of applying the feed permits the operator to use both hands. When desired, a hand-operated lever can be used to replace the foot lever.

Toledo Convert-O-Matic Scale

A new design of beam scale embodying accuracy in design and construction heretofore expected only in automatic scales, has been developed by the Toledo Scale Co., Toledo, Ohio. This scale offers new features of weight control. It has a full-floating platform which stops losses caused by wear resulting from movement of the knife edge pivots on the bearings. It is possible, at any time, to put on the company's automatic indicating dial with its full-floating double pendulum mechanism. Should requirements demand an automatic scale of greater capacity, a further adaptation of the Convert-O-Matic is possible. Its total weighing capacity may be increased one to four times by adding unit weights in the same cabinet. Thus, no equipment need be scrapped when the scale is modernized, since all cabinet, lever and platform elements as originally installed are of sufficient strength, durability and accuracy to be used with the much



more accurate dial-indicating mechanism.

Features of the unit are: Pivots may be changed without honing or grinding. Extra interchangeable pivots may be kept on hand for an emergency. Longer pivots reduce the pressure on the knife edges to one-fourth of that permitted by official engineering specifications, thus increasing wear and accuracy. Three sides of the cabinet are pressed steel.

Cincinnati Semi-Automatic Infeed Unit

A semi-automatic infeed unit, consisting of a greatly improved means for rough and finish grinding cylindrical shafts having multiple diameters, has been developed by Cincinnati Grinders, Inc., Cincinnati, Ohio. This arrangement applied to a Cincinnati 14x18-in. plain self-contained grinder substantially increases the production of multiple-diameter work by grinding, and results in high labor savings.

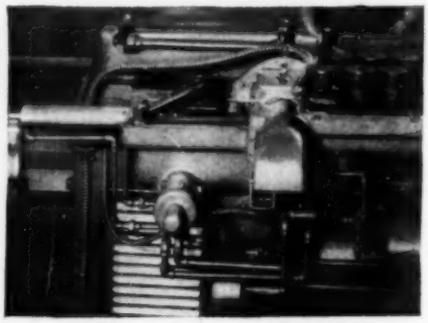
Operation of machines equipped with this unit, which is electrically and hydraulically controlled, is simple. After set-up and adjustments (13 min. being required for the 6-in. diameter shaft illustrated) the unit requires little attention until a different size shaft is to be ground. Once the shaft is placed between centers, it remains in position until completely ground. All diameters of each shaft are therefore ground with but one handling.

The semi-automatic infeed unit is located on the bed, directly in the rear of the wheelhead. Positioned in the rear of the unit is a flat master cam made up of a series of steps, each step corresponding to a diameter on the work being ground. This cam controls the relative position of the wheel and work, and the cam is machined and ground to close limits to insure consistent clearance between the work and wheel. The rear unit also contains six solenoid stops. When in use, these stops act to control the longitudinal travel of the master cam to bring the proper step on the cam in line with a positive block stop. This block stop contacts with the step on the cam representative of the diameter of the work ground.

A master drum switch with a star control wheel having six notches for this particular job is located on the front of the machine. This control wheel is indexed by station dogs as the table is hand traversed. When station dog indexes the star wheel, a corresponding contact point in the master switch is closed, which actuates the corresponding solenoid stop. This stop limits the amount of cam travel, thus bringing the proper step of the cam in line with the positive block stop for diameter sizes.

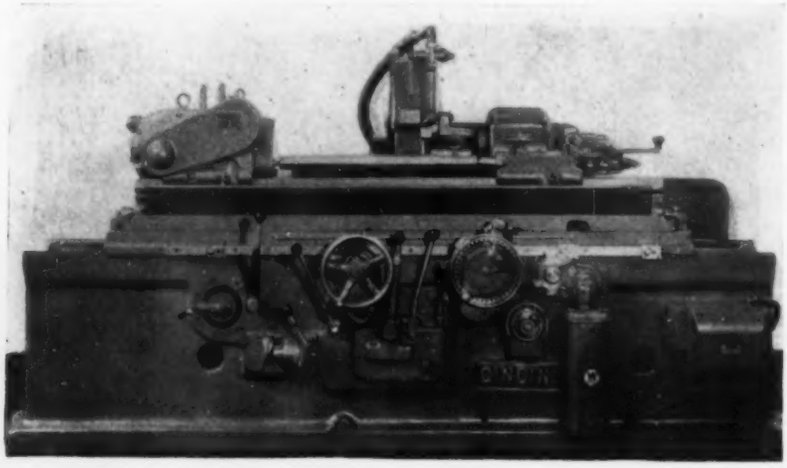
As the cross-feed handwheel is given a one-eighth turn counter-clockwise, a valve is opened which operates a piston which controls the cam bar. Wheelhead travels rapidly toward the work until the positive block stop contacts with the proper step on the cam. From this point, which positions the grinding wheel approximately $\frac{1}{64}$ in. from the work, the wheel is fed to the work by the hand infeed wheel. Limits of plus or minus 0.002 in. are held on all diameters, which are well within the tolerances usually demanded on commercial grinding.

By turning the cross-feed handwheel clockwise, the hydraulic valve is reversed and the wheel travels back to its original position. The distance of rapid cross-feed to the wheelhead is approximately $1\frac{1}{4}$ in. Accordingly all types of multiple diameter work with no greater diameter variation than 2 in. between the several diameters can be ground with the unit. By removing all the dogs on the table and setting the star wheel drum switch so that the wheelhead infeed movement will be controlled by a single cam, the machine can be efficiently used on single diameter work, a change that can be made quickly.



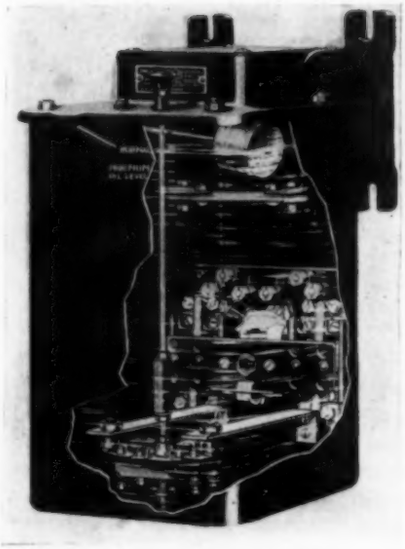
Semi-automatic infeed unit at rear of the wheelhead

To position the table type truing fixture with diamond holder for dressing the wheel, the table is hand-traversed to a predetermined position where it engages the drum switch. This energizes a solenoid which positions the stop, which determines operative position of cam with its special diamonding switch. The truing of the wheel takes place at a point beyond the largest diameter of work, thereby preventing any inadvertent interference between the wheel and the work.



Cutler-Hammer Across-the-Line A.C. Starter

An explosion-proof, across-the-line, automatic starter for a.c. squirrel cage induction motors is announced by Cutler-Hammer, Inc., 205 No. 12th St., Milwaukee, Wis. Distinguishing this starter from similar explosion-proof equipment is the immersion in



Cutler-Hammer Across-the-Line starter for hazardous locations

oil of its new thermal overload mechanism. It differs from the usual immersed oil dashpot relay and three-pole magnetic contactor in that a newly designed thermal overload mechanism is used with the contactor. The starter is designed in keeping with the latest requirements of the Underwriters Laboratories for Class 1, Group D, Hazardous Locations, including installations where Duco, lacquers, gasoline and alcohol are present in the atmosphere.

Contacts for this new starter open under a 6-in. head of oil. A special provision is made for bringing all incoming wires to the terminals below the oil level. A float-operated oil indicator shows the oil level. Threaded conduit openings and a compound filled junction box are included. The supporting structure is arranged for wall mounting and the tank is easily removed. Being completely oil immersed, the starter is corrosion resisting and therefore suitable for chemical plants and cement mills.

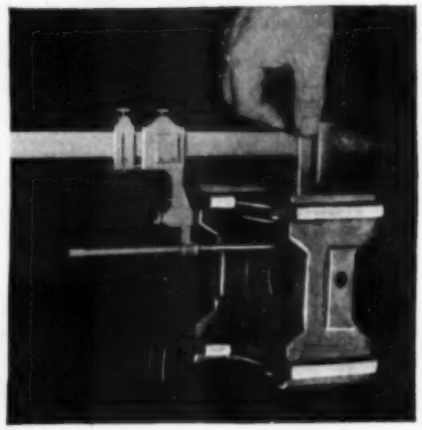
Amsco Pan-Type Conveyor

Where the pan conveyor type is indicated in handling hot or cold products or materials, either from place to place or through furnaces, the American Manganese Steel Co., Inc., Chicago Heights, Ill., is developing a conveyor of all-manganese steel or all Fahralloy, depending on whether the service is cold or not, with the following major design elements: Smooth apron surface, with or without side flanges and with or without floor and side flange overlap. Chains have one-piece links, liberal pin surface and knee-type joints which prevent sag between the supporting track wheels. No chain wear occurs except when rounding the drive sprocket. No rollers are incorporated in the chain, no leakage or spillage is claimed, and no lubrication of chain parts is considered necessary. No fouling occurs on the floor and no operating attention is required except lubrication of the shaft bearings. Conveyors are made in sizes to fit all conditions from 2 ft. to 8½ ft. in width. Manganese parts are engineered and furnished by the company and complete installations are engineered and furnished by the Stephens-Adamson Mfg. Co. The conveyor is suitable for a wide variety of uses, including assembly lines in automobile manufacturing plants.

Close-up showing the tight joint in the apron bend of the Amsco Pan-Type Conveyor

Brown & Sharpe Nos. 585A and 585B Depth Gage Attachments

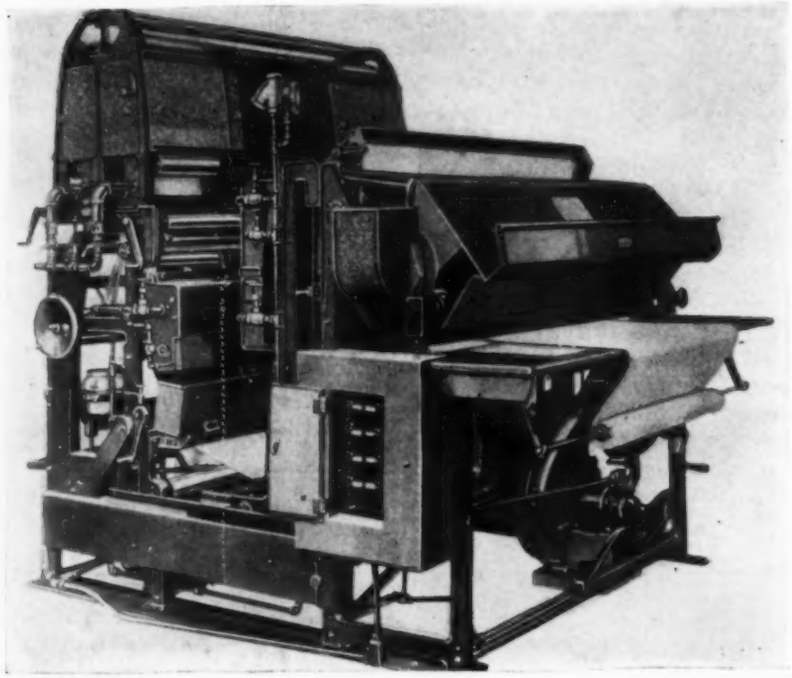
Depth gage attachments Nos. 585A and 585B for use with vernier height gages No. 585 in both the 10-and 18-in. heights have recently been announced by the Brown & Sharpe



Mfg. Co., Providence, R. I. The attachment is easily locked in place on the vernier by means of the clamp screw which can be seen in the illustration. Application of the attachment to the vernier height gage quickly converts this tool into a reliable and accurate depth gage. Measurements can be taken accurately over high projections and in deep recesses.

Typical set-up of Amsco Pan-Type Conveyor which may be all-manganese steel or Fahralloy

Pease "Peerless" Model "25" Blueprinting Equipment



A Pease "Peerless" Model "25" continuous blueprinting equipment, intermediately priced between the Pease Peerless Model "30" and the Model "20" blueprinting machines and combining many of the features of each, has been introduced by the C. F. Pease Co., 813-821 No. Franklin St., Chicago, Ill. The unit, according to the manufacturer, is particularly designed to meet both the demands of the moderate budget for blueprinting equipment and the requirements for high quality prints. It is composed of three units, the blueprinting machine, the washing machine, and the potashing, washing and drying machine. The blueprinting machine can be operated independently from the washing, potashing and drying equipment by means of a simple clutch adjustment. Also, it may be purchased separately and the other equipment added later when desired. All units are made in two sizes, 42 and 54 in. wide, and the machines can be wired to operate on 220 volts, either a.c. or d.c. The 42-in. machine is equipped with six lamps and the 54-in. machine with seven lamps. Each lamp consumes 6½ amp. on d.c. and 7½ amp. on a.c. but this amperage can be increased if faster printing is required.

This unit has a combination gear and sprocket chain drive arrangement, fully inclosed. The machine has a speed range of from 4 to 12 ft. per min., and is powered with a variable-speed ¾-hp. motor. Underneath the feed table at the right is a gear shift providing for two speeds: high, low, and neutral. Accurate printing regulation is obtained by a hand-operated dial at the front, connected by a sprocket chain to a rheostat underneath the feed table, thus providing instant change of printing speed to suit printing requirements. After exposure, when printing continuously, prints on the continuous roll of paper pass down into the first atomizer water wash consisting of spray jets which direct a pressure spray of water over the entire front and back surface of the paper. This removes all chemical and equalizes expansion or contraction of the paper. After washing, the prints pass over in contact with the chemical roll applicator in a shallow tray at the bottom center of the machine, revolving in the same direction as the paper is traveling and either potash or negative solution is uniformly applied over the surface of the prints. Both potash and hypo solutions are automatically fed into the tray from container at rear of machine and can be alternated in use as required for class of work being produced. After the developing process, prints are again washed in continuous operation as previously described by the second spray jet water wash arrangement. After this final cleansing they are carried over to the final operation of drying.

The dryer is a twin-radiator air-type consisting of two banks of heating units between which the paper travels, around a floating idler roll that can be raised or lowered by means of a crank, thus making it easy to thread the paper through the machine. The machine can be equipped with either gas or electric heater as specified at time of order, and accurate regulation is provided for controlling the drying temperature by means of individually-controlled heating units.

The gas-heated type dryer has two radiator heating units with individual gas feed lines, regulator valves, and push button pilot lighters. When operating at full capacity, each unit consumes approximately 50 cu.ft. of gas per hr. The electrically-heated type dryer has two 5-coil radiator heating units, each coil is controlled by separate toggle switches in panel box at the side of the machine. Also a contactor switch is provided so that when the drive motor is shut down all heating units are also automatically cut off in the dryer. When operating at full capacity each heating unit consumes approximately 60 amp. or a total of 120 amp.

A feature of the Model "25" dryer is the special side doors and sliding panels which assist the operator to overcome difficulties in humidity and still enable him to see the finished prints as they pass over the dryer and into the rolling up device at the rear of the machine.

The framework is of grey iron and the machine is finished in olive green enamel paint. All piping and wiring is complete ready for installation and each equipment is inspected and tested before being shipped out. The machine is lubricated by means of the Alemite greasing system and a special chart is provided to insure lubrication at proper intervals.

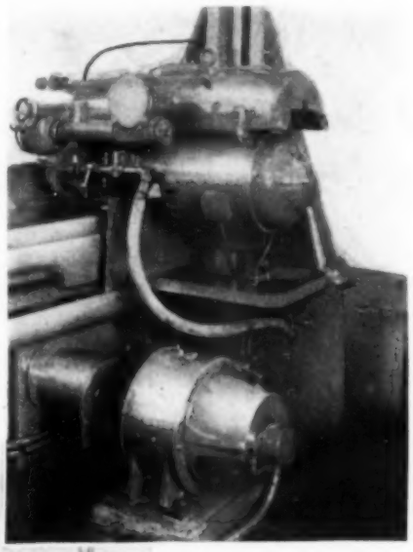
Over-all dimensions are 5 ft. 11 in. wide x 2 ft. 11¼ in. x 5 ft. 7 in. Over-all dimensions of the 54-in. blueprint-

ing machine are 6 ft. 11 in. wide x 2 ft. 11¼ in. x 5 ft. 7 in. Over-all dimensions of the 42-in. complete blueprinting equipment with gas heater are 5 ft. 11 in. wide x 7 ft. 9¾ in. x 7 ft. 3 in., and with electric heater are 6 ft. 1½ in. wide x 7 ft. 9¾ in. x 7 ft. 3 in. Over-all dimensions of the 54-in. complete blueprinting equipment with gas heater are 6 ft. 11 in. wide x 7 ft. 9¾ in. x 7 ft. 3 in. and with electric heater are 7 ft. 1½ in. wide x 7 ft. 9¼ in. x 7 ft. 3 in. or slightly wider than the gas type.

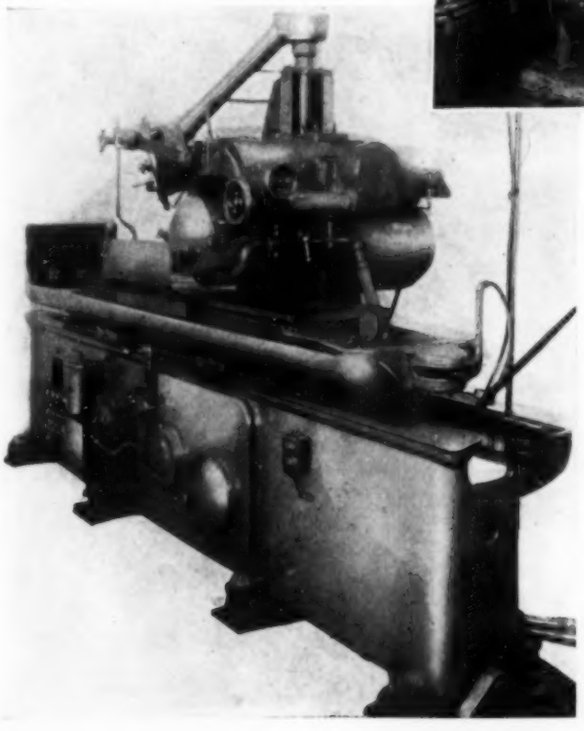
Norton Improved 15x15 In. Open-Side Surface Grinder

The Norton Co., Worcester, Mass., has brought out an improved model of the large 15x15 in. open-side surface grinding machine manufactured by the company. The feature of the new model is the design of the grinding wheel slide. The rear portion of the slide is cylindrical in shape and bored to receive a standard motor field which is pressed into place. The wheel spindle carries a standard rotor which runs in the stator with proper clearance. Wheel spindle bearings are of hard bronze, tapered on the outside for adjustment and lubricated by sight-feed oil cups on the slide. The rating of the spindle motor is 15 hp. at 1,200 r.p.m. constant speed. The unit is air cooled by circulation from a fan mounted on the rear end of the spindle.

The new arrangement eliminates the spindle pulley and countershaft formerly used, as well as three belts and a wheel drive drum and pulleys. The spindle and rotor unit is carefully balanced to run without vibration. The company claims three times as much power transmitted to the grinding wheel as was possible with the former drive. Other improvements include a new 30/1 double-worm reduction gear for the table drive, and a motor-driven "Fulflo" pump unit for the grinding lubricant. The table drive is as formerly by means of a reversing type motor coupled directly to the table drive reduction gear, the final drive being a spur gear engaging in the table rack. It is claimed that the machine is extremely quiet and smooth in operation, produces an excellent quality of finish and increases production. The machine mounts a 14x6x5 in. grinding wheel and will be built in three lengths, 6, 8 and 10 ft.



Above—Detail showing the new integral wheel-side and motor, and reversing motor table drive

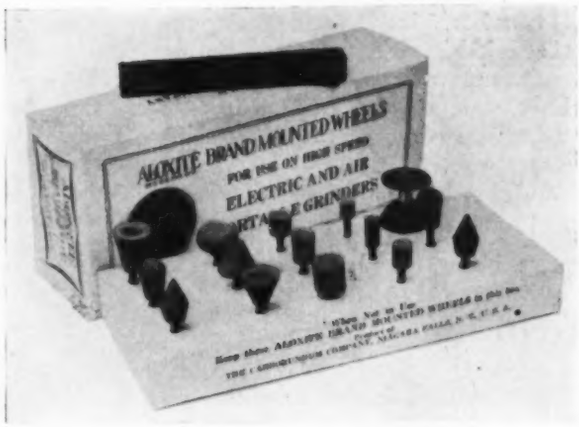


Left — Belts and pulleys are eliminated by mounting the motor on the spindle

Aloxite Brand No. 284 Production Set of Mounted Wheels and Points

The Carborundum Co., Niagara Falls, N. Y., is producing a production set of mounted wheels and points incorporating the necessary practical shapes, sizes and in the right grits and grades in both mounted wheels and points for the various types of portable grinders. This set is the result of considerable study and research in the field of grinding. Each shape is designed from the viewpoint of being practical and also to give a safe, secure mounting on the mandrel or spindle. There are no "dead" numbers or shapes in the set. Grits and gradings of the wheels assure fast, clean cutting, adequate stock removal and a superior finish on all metals and non-metals except aluminum, solder and tin, for the working of which steel burrs or rotary files are recommended.

The wheels and points are made of Aloxite Brand aluminum oxide. Spindles are copper-coated to assure a more secure mounting and give a rust-proof spindle. Included in the set are two rubber-bonded polishing wheels that can be used for giving burnished surfaces on all metals without loading or filling. In each set is also a Carborundum Brand dressing stick for the general dressing or for changing the shapes of the wheels to meet special conditions. All plain wheel shapes have a relieved end which permits the grind-



Only such shapes and numbers as are readily used are included in the set

ing of flat surfaces and blind holes. Two of the shapes can be used in die grinding, in forming the teeth of special cutters and for sharpening small circular tools.

The standard size copper-coated spindle used in the production set is $\frac{1}{8}$ in. diameter and $1\frac{1}{8}$ in. long. For dental hand pieces spindles can be furnished in $\frac{3}{32}$ in. diameter and $1\frac{1}{2}$ in. long. For certain types of grinders and flexible-shaft machines, spindles in $\frac{1}{4}$ in. diameter, $1\frac{1}{2}$ in. long can be supplied if specified.

The set is furnished packed in a neat box container in which it is recommended that the wheels and points be kept when not in use. The set is marketed under No. 824.

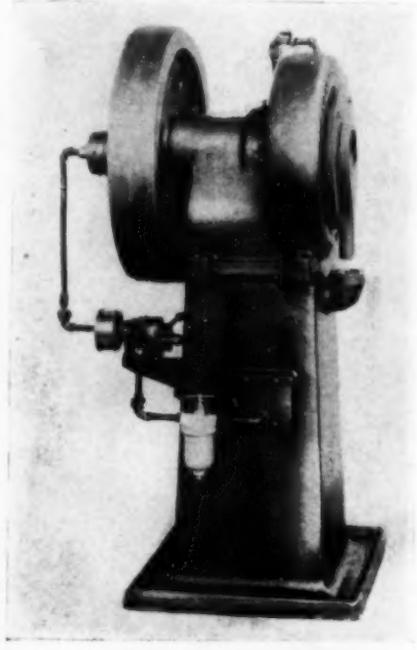
Langelier Redesigned Swaging Machines

A complete line of swaging machines incorporating radical improvements is being offered by the Langelier Mfg. Co., Providence, R. I. The machine spindle is now mounted on Timken bearings, superseding the former plain bearing mountings and providing close concentricity between the revolving spindle and the circle of headrolls, or retainer rolls. Use of these bearings also permits a much shorter and consequently more rugged spindle. Research work to determine the best possible range and capacities for these machines resulted in eleven sizes having capacities from $\frac{3}{16}$-in. diameter work on the smallest to 9-in. diameter on the largest. The first five machines of $\frac{3}{16}$, $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{8}$ and $1\frac{1}{2}$-in. maximum tube capacity have standard die lengths of 1, 2, 3, 3 and 4 in. respectively. Die lengths for the larger machines are furnished to suit customer's requirements. The three larger sizes of 5, 7 and 9-in. maximum tube capacity can be furnished either with Timken bearing spindles or with plain bearings. The plain bearing type for these three machines, however, has bronze bushings in the head and an outboard bearing with the flywheel mounted between the two. All machines are now mounted on cabinet type bases and have a large oil reservoir cast integrally. The lubricant pump is attached to the base at the rear. The pump is belt-driven from the machine spindle.

A perforated disk-type filter is inserted in the pump suction line. The discharge line from the pump is split into two leads, one going to the top of the head and the other connected to a gland in the rear of the hollow machine spindle. This arrangement permits lubricant to be fed to the dies, hammerblocks, hammerblock rolls and headrolls from two sources, one from the center outwardly, the other from the outside forced under pressure toward the center. Each discharge line is fitted with a pet cock to regulate the flow as desired. By passing the greatest possible volume through the spindle, working parts will be well lubricated and the heat from hot swaging will be carried off effectively. As a further cooling medium for hot swaging, all machines, with the exception of the "A" type (mostly for pin pointing) now have water jackets in the head. The front cover is designed to form a circular trough to catch the oil as it passes out at the front after circulating. This cover has a spout at the bottom which empties into an elbow-shaped casting fitted with a removable screen, the elbow being attached to the base and emptying into the reservoir. Two Alemite fittings supply grease to the Timken bearings. A grease seal and flinger prevents the head lubricating oil working back into the bearings.

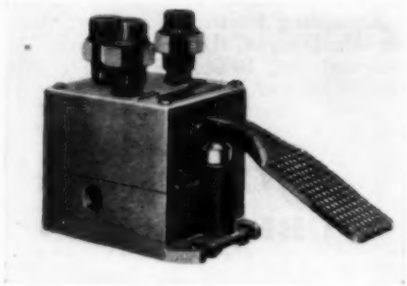
The flywheel is now webbed for greater strength and is mounted on the spindle with a taper bore and key and drawn into place by a nut locked to prevent loosening. The flywheel also serves as the driven pulley and is made crowned face for flat belt or grooved for V-belts. For self-contained machines, the motor is attached to the base and for flat belt drive the motor is equipped with a belt tightener idler. For V-belt drive, the motor is mounted on a sliding base.

The "A" machine is furnished for bench mounting only, and is not equipped with a lubricating pump. Head lubrication is supplied through a sight feed oiler at the top. The "B" and "C" machines are furnished with cages (retainer rings) for the headrolls, but can be arranged with fixed headring, as are all other machines, if desired. Special alloy steels are used for dies and other working parts. Where workholding and feeding mechanisms are required, several types and sizes are available. These are: Handwheel operated, single or compound geared, rack and pinion feed on cast-iron holder base or guide rods, hand or pneumatic clamping; hydraulically-operated (required only for the large size machines) mounted on cast-iron holder base or guide rods with individual driven pump, and with hand clamping or pneumatically-operated gripping jaws.



"Logan" Model "GN" Foot-Control Air Valve

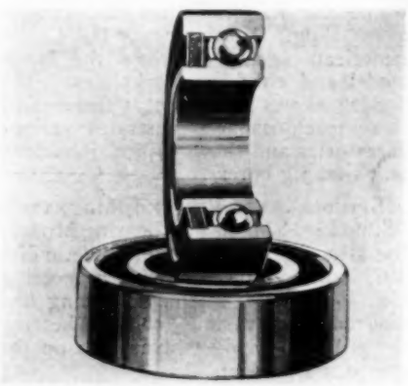
A new Model GN foot-control air valve, being introduced by the Logansport Machine Co., Logansport, Ind., is of the single-pedal reversing type. No springs are used for pedal return, thereby eliminating one cause of valve failures. A small air piston



mounted under the foot pedal automatically returns the pedal and reverses the valve when the operator's foot is removed. The foot pedal has been designed to conform to the natural position of the operator's foot. Thus it is not necessary for the operator to raise his foot off the floor to operate the pedal. The valves are regularly manufactured in $\frac{3}{8}$-, $\frac{1}{2}$-, $\frac{3}{4}$- and 1-in. pipe sizes.

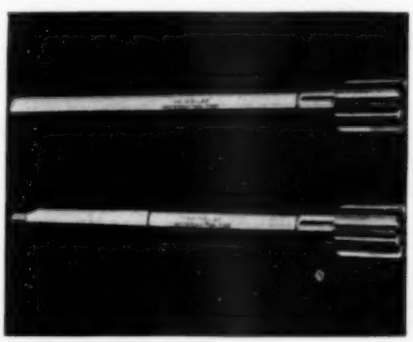
Norma-Hoffmann Series "7000" Felt-Protected Ball Bearings

In the "7000" series of felt-protected closed-type ball bearings, the Norma-Hoffmann Bearings Corp., Stamford, Conn., presents the latest addition to its line of self-protected precision ball and roller bearings. The new unit is an all-steel, lubricant-packed, dirt-and-moisture-proof bearing embodying latest improvements toward simplification in mounting and lubrication, and a reduction in cost of machining and assembling. Wide, solid inner and outer rings give maximum contact on shaft and in housing, and the design is such that the bearing can be clamped on both sides. It will carry substantial thrust loads in either direction, in combination with the radial load. The "Greaseal" feature consists of a felt washer and a thin fiber ring interposed between split snap rings held in a groove in the outer ring. The inner ring is recessed to present a shoulder which, with the felt washer, forms a labyrinth as an added safeguard against escape of lubricant. There is ample space for grease, thus reducing the attention needed for proper lubrication. The bearing is made in a full range of sizes, and interchanges in over-all dimensions with all other makes of self-protected bearings.

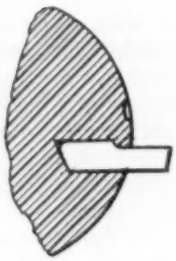


SolAD Inserted Blade Reamer

A new design of adjustable reamer, to be marketed under the registered trade name "SolAD," has been developed by the McCrosky Tool Corp., Meadville, Pa. High-speed steel blades are held in slots in an alloy steel body by peening the body metal around the blades. A ground shoulder



on the blade, just below the body diameter, allows the peened metal an extra hold. This shoulder is on the cutting side of the blade so that the peening process forces each blade against the bottom and back of its slot. The bottom of the blade is beveled crosswise and the bottom of the slot in the body is milled with a corresponding cross angle to give increased strength to the body cross-section and to permit insertion of the maximum number of blades. This detail of the design permits production of a sturdy reamer in sizes smaller than heretofore considered practical for this type.



Sectional view of the SolAD Inserted-Blade Reamer, showing the blade held in the slot by peening the body

Slots in the body are milled at a longitudinal angle that rises toward the front end. The bottom of the blades have a complementary angle. Blades adjust forward to compensate for wear and regrinding; adjustment being effected by driving the blades forward with a suitable drift. The cutting edge is always ahead of the reamer body. The body of the reamer is scored with peripheral lines to assist in adjusting the blades equally. Maximum adjustment ranges from 0.052 to 0.131 in. according to size.

Standard machine reamers of the SolAD design are furnished by thirty-seconds from $\frac{3}{4}$-in. diameter to $1\frac{1}{4}$-in. and by sixteenths to 2 in. Intermediate and decimal sizes can be furnished special to order.

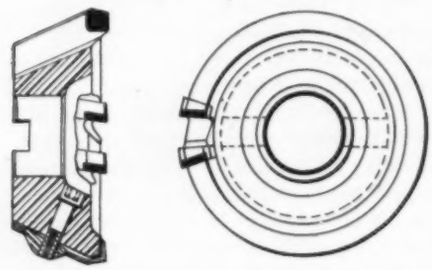
Ex-Cell-O Type "RC" and Type "R" Inserted-Blade Milling Cutters

Consistent with changing requirements for cutting tools, the Continental Tool Division of Ex-Cell-O Aircraft & Tool Corp., 1,200 Oakman Blvd., Detroit, Mich., has developed a new type of milling cutter, equally adaptable for high-speed steel, Stellite or tungsten-carbide blades, to be known as Type RC roughing and finishing milling cutter when used with Carboloy-tipped blades and Type R when used with high-speed steel or Stellite blades.

In designing the cutter body, greater strength is obtained through correct design, which insures maximum rigidity of cutter during milling operation. The cutter body is hardened and ground to give longer operating life. Cutter life will not be

affected by wear on the slots, as this is taken up by the taper on the blades. Blades for this cutter are of the wedge type, anchored securely by means of a holding clamp, each clamp anchoring two blades in position. By using the wedge type of blade and slot construction, blades can be securely anchored.

Adjustment of blades and elimination of vibration are outstanding features. An individual horizontal adjustment can be made on each blade to compensate for wear or breakage. Adjustment to the correct overhang is very important when using Ex-Cell-O-Carboloy or any tungsten-carbide cutting blade. Adjustment on this cutter does not depend upon a mechanical stop but it can be positively anchored in any position.



Construction of the Ex-Cell-O Type "RC" and "R" Milling Cutters using blades of high-speed steel, Stellite or tungsten carbide interchangeably

Correct backing is provided for each blade and pressure exerted by the holding clamp is so distributed that it will not injure Stellite when used for the cutting blades. The blade shape has been adopted after considerable experimental work which insures that each individual blade is held rigidly in the cutter body without excessive pressure from the holding clamps but at the same time permitting easy replacement or adjustment. The cutters are available from 5 in. diameter up to 24 in. diameter and larger. The number of teeth per cutter is determined by the material to be milled, type of cut to be made and type of duty the customer requires. These cutters are adaptable to the various types of drives required. In designing the blades for this cutter they were divided into three sizes, which cover the complete range of diameters. This simplifies the stock of blades and reduces the required inventory of blades. The Type R cutter embodies the same features as the Type RC in the same range of diameters.

PATENTS

AUGUST 18, 1931

Tools and Attachments

Gaging Apparatus. Erick Torvald Anderson, Hartford, Conn., assigned to The Skayef Ball Bearing Co. Patent 1,818,968.

Thread Gage. James Hartness, Springfield, Vt. Patent 1,819,025.

Portable Shearing Tool. Rene Sudre, Paris, France, assigned to Société d'Exploitation des Brevets Fort, Villiers, Neuilly-sur-Seine, France. Patent 1,819,135.

Internal Micrometer Gage. James Roy Aulenback, Worcester, Mass., assigned to Aulenback Tool Co. Patent 1,819,144.

Magnetic Testing Apparatus. James A. Rodgers, St. Louis, Mo., assigned to The Emerson Electric Mfg. Co. Patent 1,819,201.

Chuck. Humphrey R. Ward, Boston, Mass., assigned to The Warner & Swasey Co. Patent 1,819,802.

Chuck. Wilbur C. DeGraff, Cleveland, Ohio, assigned to The Warner & Swasey Co. Patent 1,819,837.

Metal-Working Machinery

Sand Blast Machine. Stephen Ernest Garratt, Manchester, England, assigned to J. W. Jackman & Co., Limited, Salford, England. Patent 1,819,021.

Nut Machine. George S. Smith, Pittsburgh, Pa., assigned, by mesne assignments, to Pittsburgh Screw and Bolt Corporation. Patent 1,819,044.

Grinding Machine. Waldo J. Guild, Ralph A. Quimby, and Frederick D. Gibbs, Worcester, Mass., assigned to The Heald Machine Co. Patent 1,819,091.

Grinding Machine. Roger N. Heald, Worcester, Mass., assigned to the Heald Machine Co. Patent 1,819,094.

Tube Swaging Machine and Method. Friederich Muller, Elizabeth, N. J. Patent 1,819,376.

Apparatus For Forming Scroll-Edge Metal Blanks. Charles D. McDonald, Chicago, Ill., assigned to McDonald Machine Co. Patent 1,819,431.

Shearing Metal Plates. Florence C. Biggert, Jr., Crafton, and Lane Johnson, Ingram, Pa., assigned to United Engineering & Foundry Co. Patent 1,819,635.

Hydraulic Pump. Percy Oliver Ott, Rockford, Ill., assigned to Racine Tool & Machine Co. Patent 1,819,689.

Speed Control Mechanism. Alfred C. Getz, Sidney, Ohio. Patent 1,819,889

Processes

Electroplating and Electroplating Apparatus. Joseph A. Smith, Attleboro, Mass., assigned to Ernst Gideon Bek, Pforzheim, Germany. Patent 1,819,130.

Method of Annealing Sheet Copper. George A. Hempstead, Lisbon, Ohio, assigned to The National Brass & Copper Co. Patent 1,819,291.

Electroplating Apparatus. James W. Hughes, Philadelphia, Pa., assigned to Budd Wheel Co. Patent 1,819,603.

Method of Forming Endless Rims for Reels, Wheels, Frames, etc. Edgar R. German, Rochester, N. Y., assigned to Taylor Shantz Co. Patent 1,819,678.

Method of Forming Metal Wheels. Lorenzo E. Waite, Erie, Pa., assigned to Erie Malleable Iron Co. Patent 1,819,854.

Furnaces

Enameling Furnace Conveyor. Robert MacDougall, Downers Grove, Ill., assigned to Beemack Furnace Co. Patent 1,819,472.

TRADE PUBLICATIONS

CAM CUTTING. The Banner Mfg. Co., Inc., 1873 Clybourn Ave., Chicago, has issued a pocket-size catalog describing the various cams, ground circular form tools, box tools, ground toolbits, swing tools, recessing swing tools, and engineering service provided by the company.

COLD FINISHED BARS. Joseph T. Ryerson & Son, Inc., 16th & Rockwell Sts., Chicago, Ill., has issued a bulletin describing the cold finished bars and cold finished steel supplied by the company.

FIRST AID MATERIALS. Catalog No. FA-2 on M-S-A First Aid Materials has been issued by the Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa., illustrating the company's line of safety appliances and first aid materials and how they are used.

PIPE FITTINGS FOR WELDING. The Taylor Forge & Pipe Works, P. O. Box 485, Chicago, Ill., has issued Bulletin 31-1 on Taylor Forge Fittings, describing the company's line of seamless steel pipe fittings for welding.

PRECISION BORER. Catalog No. 534 of the Société Genevoise d'Instruments de Physique, Geneva, Switzerland, for whom the R. Y. Ferner Co., Investment Bldg., Washington, D. C., is American agent, describes the latest model and checking workpieces. The catalog shows several new features of these machines and illustrates various accessories and shows typical jobs done on Swiss jig borers.

SPINDLE AND BEARING MOUNTING. "Simplified Spindle and Bearing Mounting Designs" is the title of Bulletin No. 102, issued by the Wyrick Engineering Co., Wyandotte, Mich., describing and diagramming various spindle bearing designs and giving tabular data on the company's products.

BELT OR CHAIN LENGTH DETERMINATION

THE table on the following page gives the length of belt in a pulley drive or chain in a sprocket drive with a minimum amount of calculation. It also gives directly the chain or belt length for more than a thousand combinations in which the sum of the radii of the pulleys or sprockets and the distance between centers is unity. For any other combination, the problem becomes one of direct proportion.

Considering the radius of the smaller pulley as r, the radius of the larger pulley as R, the distance between centers as C, and their sum as S in accordance with the accompanying figure, for values in the accompanying table $r + R + C = 1 = S$. Normally, however, S does not equal 1, so the figures must be adjusted. In using the table, add together R,r, and C to obtain S. Divide r by S, C by S, and R by S. The quotients are used as key numbers in the corresponding divisions at the margins of the table. Using C/S and r/S, find the number in the body of the table in the same horizontal line as r/S and in the same vertical line as C/S. Multiply this number by S, which is known, and the required length of belt is the result.

Example—r = 13 in., C = 67 in., R = 29 in. Therefore, S = 109 in. and r/s = 13/109 = 0.119; C/S = 67/109 = *0.615;* and R/S = 29/109 = 0.266 (used for check only). On the same line with .120 in the left-hand column and under .610 in the vertical column is 2.4823. Multiply this figure by 109, and the product, 270.538, is the required length of belt. Adding .119, .615 and .266 equals 1.000, providing a check on the result.

The result is a little too large, since the key quotients, .119 and .615, do not coincide with the marginal numbers. If an accurate length of belt is required, a sub-table with numbers interpolated can be arranged thus:

	.610	.615	.620	
.115	2.4874		2.4703	(Copy from table)
.119	2.4833	2.4749	2.4665	(Interpolations)
.120	2.4823		2.4656	(Copy from table)

Interpolate the values under .610 and .620 first and then from 2.4833 and 2.4665 interpolate to find 2.4749

Then:

$$109 \times 2.4749 = 269.764 \text{ in.}$$

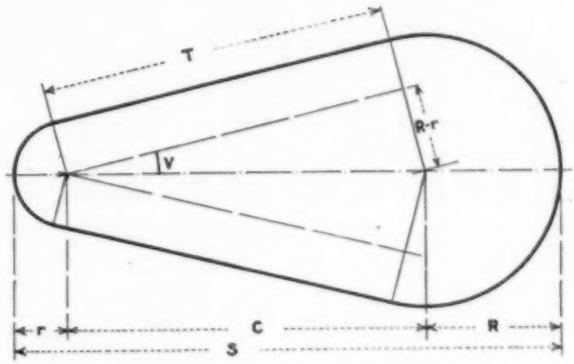
Figures in the table were computed as follows: The length of belt connecting two pulleys is the sum of four quantities, the arc on the smaller pulley, the two tangents T and the arc on the larger pulley. The length of arc on the smaller pulley is equal to the radius of the pulley multiplied by the arc for 180 deg.—twice the angle V. The angle V is obtained from its sine, which is $(R\text{-}r)/C$. The length of the tangent is equal to $\sqrt{C^2 - (R\text{-}r)^2}$. The larger arc is 180 + twice the angle V. Reducing to algebraic terms and transforming: (Let L equal the length of belt):

$$L = r \text{ (arc 180 deg.} - 2\text{arc}V) + 2\sqrt{C^2 - (R\text{-}r)^2} + R(\text{arc 180 deg.} + 2\text{arc } V)$$

$$L = 2\sqrt{C^2 - (R\text{-}r)^2} + r \text{ arc 180 deg.} - 2r \text{ arc } V + R \text{ arc 180 deg.} + 2R \text{ arc } V$$

$$L = 2\sqrt{C^2 - (R\text{-}r)^2} + (R + r) \text{ arc 180 deg.} + 2(R\text{-}r) \text{ arc } V$$

As previously stated, the sum of the two radii and the center distance between them for the values in the table equals one. For convenience while figuring, this



was taken as equal to one hundred. For example, consider the column under 0.670. This was figured as a center distance of 67 in. Two pulleys of 16.5 radius were first figured and this gave the result for the bottom number in the column.

Then pulleys of 16-in. and 17-in. radius were figured, followed by a pair of 15.5 in. and 17.5 in., and so on, until pulleys of 0 in. and 33 in. were reached. A sample of the computing is submitted.

$C = 67 \quad R = 23 \quad r = 10$

$R\text{-}r = 13$; log = 1.113943
Colog 67 = 8.173925
log sin V = 9.287868
V = 11°-11′-17″
2 V = 22°-22′-34″

$2T = 2\sqrt{67^2 - 13^2} = 131.453$
$(23 + 10)\pi = 103.673$
$13 \times .39053 = 5.077$

Arc for 22° = .38397 } 240.203 = L_{10}
Arc for 22′ = .00640 } 239.827 = $L_{10.5}$
Arc for 34″ = .00016 }
376 = d_{10}
345 = $d_{10.5}$
Check diff. = 31

$C = 67 \quad R = 23.5 \quad r = 9.5$

$R\text{-}r = 14$; log = 1.146128
log 67 = 8.173925
log sin V = 9.320053
V = 12°-02′-40″
2 V = 24°-07′-20″

$2T = 2\sqrt{67^2 - 14^2} = 131.042$
$(23.5 + 9.5)\pi = 103.673$
$14 \times .42102 = 5.894$

Arc for 24° = .41888 } 240.609 = $L_{9.5}$
Arc for 7′ = .00204 } 240.203 = L_{10}
Arc for 20″ = .00010 }
406 = $d_{9.5}$
376 = d_{10}
Check diff. = 30

$C = 67 \quad R = 24 \quad r = 9$

$R\text{-}r = 15$; log = 1.176091
Colog 67 = 8.173925
log sin V = 9.350016
V = 12°-56′-13″
2 V = 25°-52′-26″

$2T = 2\sqrt{67^2 - 15^2} = 130.599$
$(24 + 9)\pi = 103.673$
$15 \times .45159 = 6.774$

Arc for 25° = .43633 } 241.046 = L_9
Arc for 52′ = .01513 } 240.609 = $L_{9.5}$
Arc for 26″ = .00013 }
437 = d_9
406 = $d_{9.5}$
Check diff. = 31

It is to be noted that each quantity in the table was figured independently. Quantities were checked by subtracting from each one the previous item. Differences thus obtained were subtracted in the same manner and this secondary difference was almost a constant for all of the items in the same column. The fact that the secondary difference did not vary was proof of the work. The computations were carried to six figures, but only the first five are listed. The last figure is adjusted.

Contributed by Clinton C. Hubbell

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BELT OR CHAIN LENGTH DETERMINATION—Continued

r/S	C/S .500	.510	.520	.530	.540	.550	.560	.570	.580	.590	.600	.610	.620	.630	.640	.650	.660	.670	.680	.690
0	3.1416	3.0862	3.0369	2.9915	2.9487	2.9086	2.8705	2.8342	2.8097	2.7666	2.7349	2.7043	2.6750	2.6468	2.6194	2.5930	2.5675	2.5428	2.5189	2.4957
.005	3.1129	3.0611	3.0139	2.9700	2.9287	2.8897	2.8527	2.8174	2.7837	2.7515	2.7205	2.6907	2.6620	2.6344	2.6077	2.5818	2.5569	2.5327	2.5092	2.4865
.010	3.0863	3.0371	2.9918	2.9493	2.9094	2.8715	2.8355	2.8011	2.7683	2.7368	2.7066	2.6775	2.6494	2.6224	2.5963	2.5710	2.5466	2.5229	2.5000	2.4777
.015	3.0612	3.0142	2.9705	2.9294	2.8906	2.8538	2.8188	2.7853	2.7533	2.7226	2.6930	2.6646	2.6372	2.6108	2.5853	2.5605	2.5366	2.5134	2.4910	2.4692
.020	3.0374	2.9921	2.9499	2.9101	2.8725	2.8367	2.8026	2.7700	2.7388	2.7088	2.6800	2.6522	2.6254	2.5996	2.5746	2.5504	2.5270	2.5043	2.4823	2.4610
.025	3.0145	2.9709	2.9301	2.8915	2.8550	2.8202	2.7870	2.7552	2.7247	2.6955	2.6673	2.6402	2.6140	2.5888	2.5643	2.5407	2.5177	2.4956	2.4740	2.4531
.030	2.9926	2.9505	2.9110	2.8735	2.8380	2.8042	2.7718	2.7408	2.7111	2.6826	2.6551	2.6285	2.6030	2.5783	2.5544	2.5312	2.5088	2.4871	2.4660	2.4455
.035	2.9714	2.9308	2.8925	2.8561	2.8216	2.7887	2.7571	2.7269	2.6979	2.6701	2.6432	2.6173	2.5923	2.5681	2.5448	2.5222	2.5002	2.4790	2.4583	2.4383
.040	2.9511	2.9118	2.8746	2.8393	2.8057	2.7736	2.7429	2.7135	2.6852	2.6580	2.6318	2.6065	2.5820	2.5584	2.5356	2.5134	2.4920	2.4711	2.4509	2.4313
.045	2.9315	2.8934	2.8574	2.8231	2.7904	2.7591	2.7292	2.7005	2.6729	2.6463	2.6207	2.5960	2.5721	2.5491	2.5267	2.5050	2.4840	2.4637	2.4439	2.4247
.050	2.9126	2.8757	2.8407	2.8073	2.7755	2.7451	2.7159	2.6879	2.6610	2.6350	2.6100	2.5859	2.5626	2.5400	2.5181	2.4970	2.4764	2.4565	2.4371	2.4183
.055	2.8944	2.8586	2.8246	2.7822	2.7612	2.7315	2.7031	2.6758	2.6495	2.6242	2.5998	2.5762	2.5534	2.5313	2.5099	2.4892	2.4691	2.4496	2.4307	2.4123
.060	2.8768	2.8421	2.8090	2.7775	2.7473	2.7184	2.6907	2.6641	2.6384	2.6137	2.5899	2.5668	2.5445	2.5230	2.5021	2.4818	2.4622	2.4431	2.4246	2.4066
.065	2.8599	2.8261	2.7940	2.7633	2.7339	2.7058	2.6788	2.6528	2.6278	2.6036	2.5803	2.5578	2.5361	2.5150	2.4946	2.4748	2.4555	2.4369	2.4188	2.4011
.070	2.8435	2.8107	2.7795	2.7496	2.7210	2.6936	2.6672	2.6419	2.6175	2.5939	2.5712	2.5492	2.5279	2.5073	2.4874	2.4680	2.4492	2.4310	2.4132	2.3960
.075	2.8277	2.7959	2.7655	2.7364	2.7086	2.6818	2.6562	2.6314	2.6076	2.5846	2.5624	2.5409	2.5201	2.5000	2.4805	2.4616	2.4432	2.4254	2.4080	2.3912
.080	2.8125	2.7815	2.7520	2.7237	2.6966	2.6705	2.6455	2.6214	2.5981	2.5757	2.5540	2.5330	2.5127	2.4931	2.4740	2.4555	2.4375	2.4201	2.4031	2.3866
.085	2.7978	2.7677	2.7390	2.7114	2.6850	2.6596	2.6352	2.6117	2.5890	2.5671	2.5459	2.5255	2.5056	2.4864	2.4678	2.4497	2.4322	2.4151	2.3985	2.3824
.090	2.7837	2.7544	2.7264	2.6996	2.6739	2.6492	2.6253	2.6024	2.5803	2.5589	2.5383	2.5183	2.4989	2.4801	2.4620	2.4443	2.4271	2.4105	2.3942	2.3785
.095	2.7700	2.7416	2.7144	2.6883	2.6632	2.6391	2.6159	2.5935	2.5719	2.5511	2.5309	2.5114	2.4925	2.4742	2.4564	2.4392	2.4224	2.4061	2.3902	2.3748
.100	2.7569	2.7292	2.7028	2.6773	2.6529	2.6294	2.6068	2.5850	2.5640	2.5436	2.5240	2.5049	2.4864	2.4685	2.4512	2.4343	2.4180	2.4020	2.3865	2.3715
.105	2.7443	2.7174	2.6916	2.6669	2.6431	2.6202	2.5982	2.5769	2.5564	2.5365	2.5174	2.4987	2.4807	2.4632	2.4463	2.4298	2.4138	2.3983	2.3831	2.3684
.110	2.7321	2.7060	2.6809	2.6568	2.6337	2.6114	2.5899	2.5692	2.5492	2.5298	2.5111	2.4929	2.4753	2.4583	2.4417	2.4257	2.4100	2.3948	2.3800	2.3657
.115	2.7205	2.6951	2.6707	2.6472	2.6247	2.6030	2.5820	2.5618	2.5423	2.5234	2.5051	2.4874	2.4703	2.4536	2.4375	2.4218	2.4065	2.3917	2.3772	2.3632
.120	2.7093	2.6846	2.6608	2.6380	2.6161	2.5949	2.5745	2.5548	2.5358	2.5174	2.4996	2.4823	2.4656	2.4493	2.4336	2.4182	2.4033	2.3888	2.3747	2.3610
.125	2.6986	2.6746	2.6515	2.6293	2.6079	2.5873	2.5674	2.5482	2.5297	2.5117	2.4944	2.4775	2.4612	2.4453	2.4299	2.4150	2.4004	2.3863	2.3725	2.3591
.130	2.6884	2.6650	2.6452	2.6209	2.6001	2.5800	2.5607	2.5420	2.5239	2.5064	2.4895	2.4730	2.4571	2.4416	2.4266	2.4120	2.3979	2.3841	2.3706	2.3575
.135	2.6786	2.6559	2.6340	2.6130	2.5927	2.5732	2.5543	2.5361	2.5185	2.5014	2.4849	2.4689	2.4534	2.4383	2.4237	2.4094	2.3956	2.3821	2.3690	2.3562
.140	2.6692	2.6471	2.6259	2.6054	2.5857	2.5667	2.5483	2.5306	2.5134	2.4968	2.4807	2.4651	2.4500	2.4353	2.4210	2.4071	2.3936	2.3805	2.3677	2.3552
.145	2.6604	2.6386	2.6182	2.5983	2.5791	2.5606	2.5427	2.5255	2.5087	2.4926	2.4767	2.4617	2.4469	2.4326	2.4186	2.4051	2.3919	2.3791	2.3666	2.3545
.150	2.6519	2.6310	2.6109	2.5916	2.5729	2.5549	2.5375	2.5207	2.5044	2.4886	2.4734	2.4585	2.4441	2.4302	2.4166	2.4034	2.3906	2.3781	2.3659	2.3541
.155	2.6439	2.6236	2.6041	2.5852	2.5671	2.5496	2.5326	2.5162	2.5004	2.4851	2.4702	2.4557	2.4417	2.4281	2.4149	2.4020	2.3895	2.3773	2.3655	2.3539
.160	2.6363	2.6166	2.5976	2.5793	2.5617	2.5446	2.5281	2.5122	2.4968	2.4818	2.4673	2.4533	2.4396	2.4264	2.4135	2.4009	2.3887	2.3769	2.3653	
.165	2.6292	2.6100	2.5916	2.5738	2.5566	2.5400	2.5240	2.5085	2.4935	2.4789	2.4648	2.4511	2.4379	2.4249	2.4124	2.4002	2.3883	2.3767		
.170	2.6225	2.6038	2.5859	2.5686	2.5519	2.5358	2.5202	2.5051	2.4905	2.4764	2.4627	2.4493	2.4364	2.4238	2.4116	2.3997	2.3881			
.175	2.6162	2.5981	2.5807	2.5638	2.5476	2.5320	2.5168	2.5021	2.4879	2.4742	2.4608	2.4478	2.4353	2.4230	2.4111	2.3996				
.180	2.6103	2.5927	2.5758	2.5595	2.5437	2.5285	2.5137	2.4995	2.4857	2.4723	2.4593	2.4467	2.4345	2.4226	2.4110					
.185	2.6048	2.5878	2.5713	2.5555	2.5402	2.5254	2.5111	2.4972	2.4838	2.4708	2.4581	2.4459	2.4340	2.4224						
.190	2.5997	2.5832	2.5673	2.5519	2.5370	2.5227	2.5087	2.4953	2.4822	2.4696	2.4573	2.4454	2.4338							
.195	2.5951	2.5790	2.5636	2.5486	2.5342	2.5203	2.5068	2.4937	2.4810	2.4687	2.4568	2.4452								
.200	2.5909	2.5753	2.5603	2.5458	2.5318	2.5183	2.5052	2.4925	2.4802	2.4682	2.4566									
.205	2.5871	2.5720	2.5574	2.5433	2.5298	2.5166	2.5039	2.4916	2.4797	2.4681										
.210	2.5836	2.5690	2.5549	2.5413	2.5281	2.5154	2.5030	2.4911	2.4795											
.215	2.5806	2.5665	2.5528	2.5396	2.5268	2.5144	2.5025	2.4909												
.220	2.5780	2.5643	2.5511	2.5383	2.5259	2.5139	2.5023													
.225	2.5758	2.5625	2.5497	2.5373	2.5253	2.5137														
.230	2.5740	2.5612	2.5487	2.5367	2.5251															
.235	2.5726	2.5602	2.5482	2.5366																
.240	2.5716	2.5596	2.5480																	
.245	2.5710	2.5594																		
.250	2.5708																			

DIRECTIONS

Let r equal radius of smaller pulley or sprocket, R equal radius of larger pulley or sprocket, C the distance between their centers, and S equal to the sum of r, R, and C. First add r, R, and C to get S. Divide R by S, r by S, and C by S. The sum of these results should equal one —a check for accuracy. Using r/S and C/S as key numbers, enter the table and find the number given there. This number multiplied by S gives belt length. Interpolate between numbers where necessary for accuracy.

r/S	C/S .700	.710	.720	.730	.740	.750	.760	.770	.780	.790	.800	.810	.820	.830	.840	.850	.860	.870	.880	.890
0	2.4731	2.4513	2.4300	2.4093	2.3892	2.3695	2.3504	2.3318	2.3136	2.2959	2.2786	2.2617	2.2452	2.2290	2.2132	2.1978	2.1827	2.1679	2.1534	2.1392
.005	2.4644	2.4430	2.4221	2.4019	2.3821	2.3629	2.3441	2.3259	2.3080	2.2907	2.2737	2.2571	2.2409	2.2250	2.2095	2.1944	2.1795	2.1650	2.1508	2.1368
.010	2.4561	2.4350	2.4146	2.3947	2.3754	2.3565	2.3381	2.3202	2.3027	2.2857	2.2690	2.2527	2.2368	2.2213	2.2061	2.1912	2.1766	2.1623	2.1484	2.1347
.015	2.4480	2.4274	2.4074	2.3879	2.3689	2.3504	2.3324	2.3148	2.2977	2.2809	2.2646	2.2486	2.2330	2.2177	2.2028	2.1882	2.1739	2.1599	2.1462	2.1328
.020	2.4402	2.4200	2.4004	2.3813	2.3627	2.3446	2.3269	2.3097	2.2929	2.2765	2.2604	2.2448	2.2295	2.2145	2.1998	2.1855	2.1715	2.1577	2.1443	2.1311
.025	2.4328	2.4130	2.3938	2.3750	2.3568	2.3391	2.3217	2.3048	2.2884	2.2723	2.2565	2.2412	2.2261	2.2115	2.1971	2.1830	2.1693	2.1558	2.1426	2.1296
.030	2.4256	2.4062	2.3874	2.3691	2.3512	2.3338	2.3168	2.3003	2.2841	2.2683	2.2529	2.2378	2.2231	2.2087	2.1946	2.1808	2.1673	2.1541	2.1411	2.1284
.035	2.4188	2.3998	2.3814	2.3634	2.3459	2.3288	2.3122	2.2959	2.2801	2.2646	2.2495	2.2347	2.2203	2.2061	2.1923	2.1788	2.1655	2.1526	2.1398	2.1274
.040	2.4122	2.3936	2.3756	2.3580	2.3408	2.3241	2.3078	2.2919	2.2764	2.2612	2.2464	2.2319	2.2177	2.2038	2.1903	2.1770	2.1640	2.1513	2.1388	2.1266
.045	2.4060	2.3878	2.3701	2.3528	2.3361	2.3197	2.3037	2.2881	2.2729	2.2580	2.2435	2.2293	2.2154	2.2018	2.1885	2.1755	2.1627	2.1503	2.1380	2.1260
.050	2.4000	2.3822	2.3649	2.3480	2.3316	2.3155	2.2998	2.2846	2.2697	2.2551	2.2408	2.2269	2.2133	2.2000	2.1870	2.1742	2.1617	2.1495	2.1375	2.1257
.055	2.3944	2.3770	2.3600	2.3434	2.3273	2.3116	2.2963	2.2813	2.2667	2.2524	2.2385	2.2248	2.2115	2.1984	2.1856	2.1731	2.1609	2.1489	2.1371	2.1256
.060	2.3890	2.3720	2.3554	2.3392	2.3234	2.3080	2.2930	2.2783	2.2640	2.2500	2.2363	2.2230	2.2099	2.1971	2.1846	2.1723	2.1603	2.1485	2.1370	
.065	2.3840	2.3673	2.3510	2.3352	2.3197	2.3046	2.2899	2.2756	2.2615	2.2479	2.2345	2.2214	2.2085	2.1960	2.1837	2.1717	2.1599	2.1484		
.070	2.3792	2.3629	2.3470	2.3314	2.3163	2.3016	2.2872	2.2731	2.2594	2.2460	2.2328	2.2200	2.2074	2.1952	2.1831	2.1714	2.1598			
.075	2.3748	2.3588	2.3432	2.3280	2.3132	2.2988	2.2847	2.2709	2.2574	2.2443	2.2314	2.2189	2.2066	2.1946	2.1828	2.1712				
.080	2.3706	2.3549	2.3397	2.3248	2.3104	2.2962	2.2824	2.2689	2.2558	2.2429	2.2303	2.2180	2.2060	2.1942	2.1827					
.085	2.3667	2.3514	2.3365	2.3220	2.3078	2.2939	2.2804	2.2672	2.2544	2.2418	2.2295	2.2174	2.2056	2.1941						
.090	2.3631	2.3481	2.3336	2.3193	2.3055	2.2919	2.2787	2.2658	2.2532	2.2409	2.2288	2.2170	2.2055							
.095	2.3598	2.3452	2.3309	2.3170	2.3035	2.2902	2.2773	2.2647	2.2523	2.2402	2.2285	2.2169								
.100	2.3568	2.3425	2.3286	2.3150	2.3017	2.2887	2.2761	2.2637	2.2517	2.2399	2.2283									
.105	2.3541	2.3401	2.3265	2.3132	2.3002	2.2875	2.2752	2.2631	2.2513	2.2397										
.110	2.3516	2.3380	2.3247	2.3117	2.2990	2.2866	2.2745	2.2627	2.2512											
.115	2.3495	2.3361	2.3231	2.3104	2.2980	2.2859	2.2741	2.2626												
.120	2.3476	2.3346	2.3219	2.3095	2.2974	2.2855	2.2740													
.125	2.3461	2.3333	2.3209	2.3088	2.2970	2.2854														
.130	2.3448	2.3323	2.3202	2.3084	2.2968															
.135	2.3438	2.3316	2.3198	2.3082																
.140	2.3431	2.3312	2.3197																	
.145	2.3426	2.3311																		
.150	2.3425																			

r/S	.900	.910	.920	.930	.940	.950	.960	.970	.980	.990
0	2.1253	2.1117	2.0983	2.0852	2.0723	2.0597	2.0473	2.0352	2.0233	2.0115
.005	2.1232	2.1098	2.0967	2.0838	2.0712	2.0588	2.0466	2.0347	2.0229	2.0114
.010	2.1213	2.1081	2.0952	2.0826	2.0702	2.0580	2.0461	2.0344	2.0228	
.015	2.1196	2.1067	2.0941	2.0816	2.0695	2.0575	2.0458	2.0343		
.020	2.1182	2.1055	2.0931	2.0809	2.0689	2.0572	2.0457			
.025	2.1169	2.1045	2.0923	2.0803	2.0686	2.0571				
.030	2.1159	2.1037	2.0918	2.0800	2.0685					
.035	2.1152	2.1032	2.0914	2.0799						
.040	2.1146	2.1029	2.0913							
.045	2.1143	2.1027								
.050	2.1142									

EXAMPLE

r	= 13″;	r/S	= 13/109 = .119
R	= 29″;	R/S	= 29/109 = .266
C	= 67″;	C/S	= 67/109 = .615
S	= 109	Checking.....	= 1.000

Entering table: under .610 and across from .120 is 2.4823. .109x2.4823 = 270.538 in., the required length of belt. By interpolating between proper values, the belt length will be found to be 109x2.4749 = 269.764 in.

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Miracle

Until very recent weeks it was all too apparent that many swivel-chair business men were awaiting a miracle to ride them back to pre-crash prosperity—"just settin' and awaitin' for suthin' to turn up." Whether they were praying to high heaven or to earthy Washington is not germane; the miracle they longed for refused to happen. It is just as well, because no man in his right senses would wish a return to the neurotic, cocktail prosperity of 1929.

But something like a miracle has happened and is happening. As noted elsewhere, one of the keenest sales managers we know has returned from an intensive three thousand mile trip. He spent three weeks calling unannounced on dozens of top executives in a diversity of major industries. With but one exception every single man was at his station, on the job and not just settin' and awaitin'. Executives know now that our industrial, economic and social salvation depends upon them.

Gone are their summerings at Placid and winterings at Miami. They mean business and they will make business.

Congress is Coming

The Farm Board's proposal to destroy cotton crops would be ludicrous were it not so hopelessly tragic. This recommendation marks and typifies the low ebb of loose thinking on business economics. It exemplifies how the persistent buck passing between producers and governmental agencies can be carried to an absurdity. Perhaps there is a ray of hope in all this. After a nation reaches the foolish stage, it is ready to take a new and sounder tack.

More hopeful still is President Hoover's appointment of Walter S. Gifford to head a Federal board for the mobilization of idle relief. Obviously, this move is to forestall ill-advised action by the coming Congress. This in itself is a worthy cause aside from the crying need for the coordinated action that the Gifford Board promises. Just now, with business nerves jumpy, drastic legislation would be deplorable. Statutes passed to meet an emergency have a way of overreaching their mark only to boomerang back and retard the very cause they were designed to advance.

More power to Gifford and his relief program. May his activities be so effective that Congressional interference will be held within innocuous limits.

The Tearful Tale of Mustapha Mazda

And it came to pass in the month of Ramdam that Letsera Bray, sultan of Bananastan, spake thus unto his trusty pshaw, Mustapha Mazda, "Arise and go now unto the royal wine cellar at Popgulp. Make haste and bring unto thy sultan a skin full of giggle water so that my august augustness, my harem, and my court may tipple and rejoice."

So Mustapha Mazda salaamed, bestrode the sultan's trusty camel, Cellophane, and departed fresh. Upon the third day he came to Popgulp and did get the skin full of giggle water. But there was much heat in that country, and the skin, unlike its contents, waxed weaker with age, until lo! it sprang a leak. Forthwith did Mazda seek out the local taxidermist for a new giggle container.

Now it chanced that in stock the taxidermist did carry a fine new skin priced at five ninety-eight. But he permitted Mazda to buy for his skin a patch for two bits and to save the difference.

Again did another leak appear in the skin, and again Mazda, seeing not the light, bought a patch. Again and again, a score and two times, did other

leaks befall, and yet did not Mazda see the light. At first he did buy patches for the skin to save the old skin, then did he buy him more patches to save the first patches. He did waste so much time and spill so much giggle water that even the wayside Sphinxes did giggle.

So it was that when Mustapha Mazda did finally stand before the sultan, Letsera Bray was most wroth. "Verily must I know why thou didst take twice seven days to make a seven-day journey, even when thou didst bestride my freshest camel, Cellophane! Why comest thou before me bearing a bundle of patches? Again, where is the giggle water?"

Then did Mustapha Mazda salaam thrice thirteen times, seeing the light not even yet, saying, "Fifty hails and seventy-five hozannas, my master. By careful shopping and myself sewing on the patches, I did save thee forty-eight cents."

Too much was this for Letsera Bray. Thrice did he smite his chest. "Die, son of an owl. Knowest thou not that the prophet has said, 'It is better to replace than to repair'?"

Then, and then only, did Mustapha Mazda see the light, but lo! it promptly faded. Letsera Bray saw to that.

◂◂ CHIPS ▸▸

Evidence accumulates that economists augment depressions and booms with their undetailed indexes of national business activity . . . During depressions the highlights are lost in the shadows . . . The reverse during booms . . . Small wonder that business men become confused and stampeded this way or that.

Manufacturers will do well to watch the highlights and direct activities accordingly . . . Like the dowager's advice to her daughter—"Don't marry for money, my dear, but it won't do you any harm to meet all the wealthy young men you can."

"People may talk about bringin' business back, but you can't bring anything back without goin' after it."
—JABBY, *Cleveland Plain Dealer.*

In this country recovery has always started in the East and marched toward the West . . . New England, with her textiles and shoes, is the bright spot geographically . . . United Shoe Machinery goes back on a full five day week for its three thousand employees . . . Shoe manufacturing bulges up eighteen per cent . . . Textile mill operations up fifteen per cent.

Even outside New England we find activity . . . Utilities gain three per cent in net income over 1930 . . . Silk industry twenty-six . . . Telephone companies nine . . . coal fifty . . . Packard ships 1,999 cars in July—best month since last October . . . July was also kind to Willys-Overland—sales almost sixteen per cent better than last year . . . Hooven, Owens, Rentschler Company books 1,500,000 dollar order for five Diesel-powered generating sets.

BANKS AND NEW TOOLS

"There are plenty of articles and advertisements setting forth arguments why machine tools should be replaced because of new improvements, obsolescence, etc., but never a word as to how a small manufacturer can raise money to do this.

As you no doubt know, a large percentage of the manufacturing in the United States is done in small plants, and if you are at all familiar with the small manufacturer and his trouble in obtaining banking accommodations, you can readily see that it is impossible to obtain new equipment without the small manufacturer obligating himself, his family and his friends. Even then the accommodation is for a short period only.

"Banks do not care to accommodate small manufacturers because they are mostly one-man concerns; to liquidate the small concern is a losing proposition according to the banks' idea.

"In times gone by, father or grandfather could go to their banks and obtain accommodations upon reasonable terms, as the small manufacturer and banker were acquainted with one another's problems. But let the son or grandson try to obtain accommodations to purchase new tools or raw material and then what happens? As small manufacturers cannot show large profits or turn-overs, and in most cases are one-man concerns, the banker fears something might happen to the owner. In the event of liquidation, the banker would receive junk prices for a small plant.

"The banker requires that the small plant owner mortgage his plant and his home, have his wife sign with him, then get some of his friends to sign, just for a ninety-day loan, the interest being taken out when the loan is granted.

"Now if the big machine tool manufacturers desire to obtain some profitable business during slack times why don't they look up a banking concern, or someone who would understand the small manufacturing game and its limitations, so that the small manufacturer could obtain reasonable banking accommodations to purchase new tools, machines, etc., without swearing away his very life?

"Naturally, the machine tool manufacturer will say that the small concern should have a reserve, and they all have; but as their profits are small, due in many cases to foreign competition and 'lack of buy in the U.S.A. spirit,' the small manufacturer feels that his reserve is necessary to keep his few employees going, even if only part time. The small manufacturer feels his obligations more keenly because his employees are almost like his own family and have grown old with him, yet the small manufacturer knows that his equipment is old and needs replacing, having in many cases been handed down to him by his father who could obtain better banking accommodations because he was on a more equal footing with his banker and there was not so much marble and gold-plated grill-work as now.

"The banks have plenty of money to gamble with, but none for the small manufacturer who is the foundation of this country and pays out the largest amount in payroll so that the merchant can live and banks can gamble in Wall Street."
—A. W. AINSWORTH.
Wm. Ainsworth & Sons Inc.

AMERICAN MACHINIST AWARDS

September 1, 1931, is the date on which the contest closes, and not 1930 as was printed in this column last week. The winners will be announced in October.

Another fine brief arrived last Friday. Mail yours this week without fail, and do not forget to include a statement about your annual average volume. There are two Awards, one for plants doing a million dollars or more annually, the other for plants doing less than a million.

"There is a growing tendency in business to travel by jumps. Jumping is not an efficient method of locomotion. . . . . Building a successful business is really a slow deliberate process. . . . Jumping is a form of hysteria. . . . Business faces a ten year climb. But one advantage of being at the bottom—you at least know in which direction you are going."—*The Wedge*.

THIS WEEK IN *AM*

Balance applies to thousands of things, but Chester B. Lord, associate editor, chooses characteristically to be strictly practical. In the leading article for this issue he takes up the subject of static balance and shows how its problems can best be handled in the shop.

Nikola Trbojevich, research engineer, The Timken-Detroit Axle Co., has released his fine paper, "Some Advanced Worm Hob Designs," (page 348). Ken G. Niblack, Bausch & Lomb, continues his notable series on optical instruments for metal working shops (page 346). The Marmon Sixteen serial goes forward with a description of production practices on cylinder heads, sleeves and tappets (page 344).

If common or gardener size is the only criterion, a little one page article on how to produce hot-rolled pinions of nickel steel might easily be passed by. But James R. Cornelius, English machine and tool designer, has packed a lot of sound information into less than a thousand words (page 335).

Under the title of "Relocation, Rearrangement, Re-equipment," Thomas O. Ford shows what the Norton Company did to bring its plant to top effectiveness (page 339). And by all means cast an inquiring eye over the Reference Book Sheet—a genuine time, pencil and mistake saver contributed by Clinton C. Hubbell. Shop Equipment News contains many important new developments.

One of the keenest sales managers we know has just returned from a three-weeks swing around the circle . . . made dozens of cold calls . . . found every executive he wanted to see but one on the job . . . Good sign . . . Depression may regenerate some of our executive playboys yet . . . may develop real business men.

O. L. Egtvedt, vice president of Boeing Airplane, assumes direct management of his company . . . G. W. Carr becomes plant manager . . . Frank W. Jones is elected vice president and general manager of Hanover Wire Cloth Company . . . Worthington Pump and Machinery Corporation acquires the manufacturing and marketing facilities of Metalweld, Inc. . . . J. S. Wilson is the new superintendent of shops at Detroit for the Michigan Central.

Both Europe and America are beginning to face realities . . . International bankers' committee, headed by Wiggin, advises immediate German reparations cut . . . Washington, with one eye on Congress and the other on 1932, will frown officially for five or six months . . . calls the idea premature . . . France and Russia sign non-aggression treaty, whatever that means . . . Canada flirts for more American branch plants by threatening further tariff increases . . . President Hoover names Gifford Relief Committee . . . "Food for Starving Americans" has a familiar ring to it . . . What kind of a campaign slogan it will make is something else again . . . There will be no extra session of Congress . . . Sighs of relief are heard on every hand.

• COMING •

While America has been accelerating her engineering and inventive abilities, other nations have not been standing idly by. Forced by economic necessities more urgent than ours, Germany has been making strides. Increasingly, it becomes the duty of *AM* to keep abreast and even ahead of developments wherever they may occur. In the next issue we shall go into the details of a notable German profile grinder, fully illustrated with photographs and drawings.

Mechanical feeds for punch presses are time and finger conservers. Several examples will be illustrated and explained next week. The optical and the Marmon Sixteen series will be completed.

The omnipresent electron is on the job. Since the vacuum tube came into being, the electron has not been troubled with unemployment. Next week we shall show one of his newer jobs in the grid-glow micrometer. The numberless applications for the device will be apparent.

THE . INDUSTRY .

Progress in Metal-Working and Machinery Markets

AUGUST, normally any year's lowest month, ends lower than usual this year. Orders, except from municipal and government sources, are few and far between, and inquiries seem only requests for catalog information. On every hand the same tiresome and time-worn answer is given, "When business improves." Meanwhile, machine tool manufacturers and dealers find their best sales efforts have little effect against the financial infantile paralysis that affects buyers. Here and there, however, are indications that general business, realizing that something beside hope and trust is needed to remedy the situation, is at last bestirring itself. These stirrings, few though they may be, indicate improvement after Labor Day.

NEW YORK awaits action on the Navy and Subway lists, with two dealers reporting better inquiries and business. Cincinnati likewise has one manufacturer reporting an increase, but the remainder experiencing dogday blues. Philadelphia sees some improvement, but none in inquiries. New England hopes for automotive orders, with four companies inquiring, while the Government, Italy, France, and electrical prospects add promise. Milwaukee likewise has automotive inquiries, but actual orders are slower. Detroit expects sales soon, but has nothing to offer now.

CHICAGO notes little change, but expects an upturn by October. Buffalo is feeling quite good about August sales, high for a vacation month, and has some school business on tap, though one school has just bought used equipment. Cleveland, with sales unchanged, finds comfort in increasing general business. Southern District, slow all summer, has oil troubles added to its other maladies.

NEW YORK

Again the week held quiet. Two dealers reported better business, one a result of government orders. The Navy list has not been ordered, and no announcement is expected for some time on the Board of Transportation subway list for 52 tools, including 8 woodworking units. Other business awaits a change in the general situation.

CINCINNATI

The machine tool business is down to hard-pan, and therefore its next movement must be upward, starting from a firm foundation. Now that the canicular days are almost over, manufacturers think it logical to expect demand to increase. Selling agents are working hard, but their principal success is in developing prospects. One manufacturer reported a slight increase in both sales and inquiries, but others were not so fortunate.

PHILADELPHIA

A few small orders from industrial concerns came in last week. The situation appears to most dealers to be somewhat improved, although the present season is not one upon which a prediction of basic conditions can be made. Inquiries were few and lacking in any indication of early closing.

NEW ENGLAND

An encouraging factor is the potential demand for tools from the automotive industry. Inquiries from this source have brightened the outlook, and no less than four leading companies are represented, with lathes, grinding equipment and drilling machinery predominating. Italy and France are inquiring in New England for machine tools. Government orders and prospective business from the electrical industry are expected to boost August sales; however, totals for the month will be nothing to write home about.

MILWAUKEE

That the tool business has gone on its August vacation is indicated in reports from the local factors. The current month will be the low spot of the year, more or less dull throughout. Municipal business for school requirements has been a bright spot but with the possible exception of a few late orders, nothing much is expected from this source from now on. Optimism is based largely on what automotiye and allied industries may require during the next few months. Inquiries for both standard and special machines are coming from these sources.

DETROIT

The tool trade here is still suffering its unusual summer depression. Sales are infrequent and immediate prospects poor. Most automobile plants either are shut down or are on slender schedules. Manufacturers expect a total production of only about 2,600,000 cars for the year, a figure considerably below expectations and substantially below 1930. Some more optimistic dealers believe the new car models will bring about a sharp increase in sales. There will be many changes in design, necessitating the purchase of some new machinery. But most auto plants are equipped to convert much of their old machinery to new uses.

CHICAGO

Little change is noted. Inquiries for a time improved, have again lapsed, and from the present outlook August will probably be the dullest month of the year. Optimism, previously reported with respect to a pick-up as the fall advances, continues. However, the general forecast is that the depressive conditions so long existing will be relieved, to a degree, by October.

BUFFALO

If August did not happen to be a vacation month, it would probably be considered a rather good month in the Buffalo machine tool trade. Some sales have been made and, among some dealers at least, there is some optimism.

It is quite evident that there is to be still more school business. Bids for equipment for the new Grover Cleveland school are to be opened late this month, and still other out-of-the-city schools are to make purchases later. Curiously, a Niagara Falls, N. Y., school purchased some used equipment.

CLEVELAND

Machine tool business, as far as actual sales are concerned, remains unchanged. Sales for replacements were the only business transacted.

All is not gloom, however; tool and die shops are increasing their business. A local tractor concern received an order for 155 tractors. Automatic machinery manufacturers report new inquiries holding their own. The New York Shipbuilding order for a 130,000-lb. planer to Cleveland Planer Co. will necessitate a night shift to complete in time. Peerless Motor Car Corporation plans to build all-aluminum cars.

SOUTHERN DISTRICT

There has been no let-up in sluggishness the past fortnight, and sales continue miserably below the levels of last year. Prices have commenced to take noticeable tumbles in the small-tool field, although they are holding fairly well for large types of equipment. Very little of the hoped for business of this season has materialized, and to add to the unfavorableness of the situation unsatisfactory conditions have developed in the oil fields of Texas and Oklahoma; this will certainly have a bearing on the markets of the Southwest territory. No inquiries of proportions worth mentioning developed. Railroads are doing hand-to-mouth buying, and shipbuilding interests continue to offer no source of demand.

WEEK . BY . WEEK

BUSINESS BAROMETER

Trends in General Business throughout the world

THEODORE H. PRICE
Editor, Commerce and Finance, New York

The whole world is economically perturbed, and the resulting attrition is commencing to impair confidence and create irritation. In some cases this distraint of business is assumed to be the result of commercial jealousy. It is, however, doubtful whether there is any element of commercial jealousy in the maladjustment now complained of. The social as well as the financial dissatisfaction which is becoming more and more widespread has manifested itself in a number of different ways. Last week there were some important bank suspensions at Toledo, Los Angeles and Omaha. Some hope that the suspended institutions may resume is given, but the best advices do not encourage it.

Business is, however, but little disturbed by the cutting of the financial wires that lead to these institutions, and the Federal Reserve System has justified its existence many times over during the last 12 or 18 months.

General Trade Improving

General trade is, moreover, improving. Steel mill operations have been increased by two per cent. Business in shoes and certain sorts of woolen and worsted goods continues remarkably active and it is hard to understand just why these two lines of trade should have had such a sudden recovery. Many explanations are offered, but the most plausible one for the improvement in shoe business seems to be that people are learning to economize by walking from their homes to work instead of riding in automobiles. Money continues easy, and anyone who wants to borrow can get all the accommodation to which he is legitimately entitled at probably the lowest rates on record.

In some parts of the American oil territory production is being held in check by the use of militia, and a slight advance in the price of petroleum has resulted in the opening of a few wells that were shut down. Public opinion recognizes the need for curtailment in the production of petroleum, and it seems unlikely that an increase in the oil output will be again permitted before the country has shown itself able to consume the present excessive supply.

This or something that will produce the same economic effect appears to be the most crying need of the world today. There is no question about the supply of the staple necessities of life with which the country is provided. There is no question about our ability to put these products in shape for market. We have labor-saving machinery that enables us to do this work more cheaply than it can be done anywhere else in the world, and we have the labor, intelligence and alertness that are necessary for the development of great industrial enterprises.

China Wants Wheat

At the present moment China is begging for wheat, and the Farm Board has announced its readiness to enter into negotiations for the sale of a quantity of Stabilization Corporation wheat to be used for relief of the flood sufferers in the Yangtse region. The deal may hinge upon China's ability to offer satisfactory credit. Some parts of India are in the throes of starvation because they lack rice. If we could distribute our surplus production quickly and economically, the whole world would be benefited. America would probably realize a fair value for its products and the problem would be solved. That it must soon be solved seems to us so obvious that we are disposed to take its solution for granted. While we are finding out our mistake millions of people are dying of starvation or deprivation. If we can so organize American business that it will be able to meet one of the most serious predicaments that it has ever been called upon to face, we shall be rendering the greatest service to the world that could be performed by any man or group of men today.

Various plans for achieving this service are being offered. If the newspapers printed all the letters and proposals that they receive, their columns would be so choked, that the publication of any other matter would be impossible. The problem of crystallizing public opinion on the subject is in itself a difficult job.

The suggestion that part of the cotton crop should be destroyed in an effort to advance the price has brought so much ridicule upon the Farm Board and its subsidiaries that their proposals are not likely to be seriously considered in the future. The question of what to do and how to do it is, therefore, the most important query that is before the world today. Upon the promptitude and adequacy with which it is answered, the immediate future of business is acutely dependent. It is for this reason that it is urged that practical men submit their views to public discussion, but in making this suggestion it is not intended to encourage the submission of propositions that are impracticable because their adoption would require an amendment to the Constitution. To procure the passage and ratification of such an amendment would require years and the business of the country would be disintegrated in the process.

On the other hand, the adoption of some workable scheme that would promise to correct the injustice from which many producers and distributors are now suffering, would bring about an almost immediate reversal in the tone and tendency of the commodity markets, as well as the stock exchanges where the economic condition of the country is reflected.

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THE BUSINESS WEEK

August 26, 1931

Though the strain of the foreign situation has temporarily eased, it is difficult to find any decisive signs of improvement in the domestic business picture . . . Our index, which has been falling slowly since March, has run into new low ground during August, and the monthly figures indicate that the level of last December, which everyone hoped was the bottom, has been slightly outdone by the mid-summer months . . . Steel activity is probably at its ebb, but as yet gives no hint of prospective fall demand . . . Building has slumped badly in August, and the trends of electric power production, merchandise carloadings, check payments and commercial loans since July show the severe effects of summer stagnation in a depression year . . . The relative stability of average commodity prices since early June is the most encouraging fundamental factor in the situation, and New England, with her textiles and shoes, is the bright spot geographically . . . Credit indicators as yet give no definite promise of an aggressive expansion policy, and a new outbreak of bank closings shows that domestic banking troubles are not over . . . Foreign financial difficulties are apparently submerged for the summer, but the frank recognition by banking conferences abroad that they are only postponed pending solution of fundamental problems of reparations, war debts and political cooperation is an accomplishment of prime importance.

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Material Trends and Prices . . . .

A very slight gain in buying of steel for use in the automotive, construction and railway industries, together with pipe-line extension, has given an impetus to mill operations within the last week. The rate is now around 32 per cent of capacity, compared with 30 per cent, last week. At any rate, a seasonal up-turn is about due. In the chief non-ferrous metals, trading is fair at the moment in copper and zinc, with lead steady and tin prices higher than a week ago.

(All prices as of Aug. 21, 1931)

IRON AND STEEL

Pig Iron—	Current	Mo. Ago	Yr. Ago
Birmingham, No. 2, Fdry., per gross ton	$12.00	$12.00	$14.00
Buffalo, No. 2, Fdry., per gross ton	17.00	17.00	16.00
Heavy Melting Steel Scrap— Pittsburgh consuming point, No. 1, per gross ton	10.50	10.00	15.25
Furnace Coke—Connellsville, per net ton	2.40	2.40	2.50
Foundry Coke—Connellsville, per net ton	3.25	3.25	3.50
Steel Shapes—Pittsburgh, base, per 100 lb	1.60	1.60	1 60

Iron Machinery Castings—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight, 275 lb:

Chicago	4.62½	Cleveland	4.50	New York	4.75
Cincinnati	4.40	Detroit	4.00		

Steel Sheets—Prices in cents per lb., del. from warehouse stock (except at Pittsburgh) in lots of 401 to 999 lb., ordered and released for shipment at one time:

	Pitts. Mill	Chicago	Cleveland	New York
Blue annealed, No. 10*	1.85	3.20	3.00	3.40
Black sheets, No. 24	2.40	3.55	3.60	3.50
Galvanized, No. 24	2.90	4.10	4.00	4.00

* Light plates.

Seamless Steel Tubing—Cold-drawn mechanical tubing round, .10 to .30 carbon, in lots of less than 100 ft. or 100 lb., net, at N. Y. warehouse:

Thickness of Wall		Outside Dia. in Inches					
	¼	⅜	½	⅝	1	1¼	1½
Inches	B.w.g.	Price per Foot					
.035	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23

Shapes, Plates, Bars, Etc.—Warehouse base prices in cents per lb., del. in lots of 401 to 999 lb., ordered and released for shipment at one time:

	New York	Cleveland	Chicago
Bands	3.40	3.00	2.95
Bars, soft steel	3.10	2.75	2.75
Cold fin., flat or square	3.90	3.60	3.60
Cold fin., round or hexagon	3.40	3.10	3.10
Cold rolled strips	4.95	6.00	5.50
Floor plates	4.85	5.00	5.00
Hoops	3.75	3.65	3.50
Rivets	4.00	4.00	4.00
Shapes	3.10	2.95	3.00
Spring steel	4.00	4.00	4.00
Tank plates	3.10	2.95	3.00

Stainless Steel—Hot-rolled bars, base, Pittsburgh, 0.12 per cent carbon, cents per lb:

Chromium		Chromium	
15% and under	19.00	18 to 23%	23.00
15 to 18%	20.50	23 to 30%	28.00

Bolts and Nuts—Discount from list, f.o.b. mills, Birmingham Chicago, Cleveland and Pittsburgh, on machine bolts, all sizes, cut thread; nuts, hot-pressed or cold punched; and lag screws, mill lots 73–10%

NON-FERROUS METALS

Prices following are in cents per lb. for mill shipments in carlots:	
Aluminum ingots, 99%, N. Y.	23.30
Copper, electrolytic, Conn	7.50
Copper wire, base, Chicago and Cleveland	9.87½
Copper wire, base, N. Y.	9.75
Lead, pigs, E. St. Louis	4.22½
Tin, Straits, pigs, spot, N. Y.	25.60
Zinc, slabs, E. St. Louis	3.80
Prices following are in cents per lb., base, N. Y., Chi. and Cleve:	
Brass rods, high	13.62½
Brass sheets, high	15.37½
Brass tubing, high	20.25
Copper, drawn round	16.12½
Copper sheets	17.62½
Copper tubing	20.12½
Prices following are in cents per lb., del. from N. Y. warehouse:	
Babbitt, anti-friction, general service	28.75
Babbitt, com'l, intermediate grade	34.50
Babbitt, genuine, highest grade	44.25
Solder, bar	19.62½
Prices following are in cents per lb., base, Huntington, W. Va:	
Monel metal rods, hot rolled	35.00
Monel metal sheets, full finished	42.00
Monel metal tubing, seamless	65.00
Nickel rods, hot rolled	45.00
Nickel sheets, full finished	52.00
Nickel tubing, seamless	75.00

Scrap Non-Ferrous Metals—Dealers' purchasing prices in cents per lb., f.o.b. cars:

	New York	Cleveland	Chicago
Heavy yellow brass	3.00	4.25	4.00@4.25
Light brass	2.50	3.25	3.25@3.75
No. 1 rod-brass turnings	3.50	4.50	4.00@4.50
Heavy copper	5.50	5.75	6.25@6.75
Light copper	4.50	5.00	5.50@6.00

SHOP SUPPLIES

(Prices at warehouse)	New York	Cleveland	Chicago
Abrasive disks, aluminum oxide mineral, cloth, 6-in. dia., No. 1, less than 200, per 100	$4.36	$4.59	$4.59
Belting, leather, heavy, discount	30–10%	40%	40%
Belting, rubber, trans., 1st grade, discount	60–10–10%	60–10%	60%

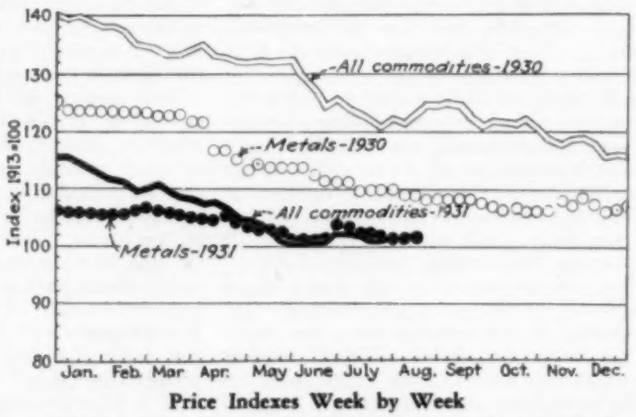
Lumber—Per M ft., b.m., 16 ft. lengths, del., N. Y:

Crating—Southern pine:

1x4-in. $27.00 1x6-in. $26.00

Skids—Spruce:

2x4-in. $37.00 3x3-in. $46.00 4x6-in. $48.00 6x6-in. $52.50



Price Indexes Week by Week

(6 Metals and 74 Commodities—Figures from The Annalist.)

NEWS

Silver Bay Conferences Continue This Week

"Security of Employment—Seeking a Solution," is the theme of this year's Silver Bay Conference on Industrial Relations, being held at Silver Bay, Lake George, N. Y., this week. Among the subjects and speakers are: "Progress in Industrial Relations," by E. S. Cowdrick; "Security of Employment—A Statement of the Problem," by Dr. Lillian M. Gilbreth; "An Experiment by a Company," by Col. J. T. Loree; "An Experiment by a Group of Industries," by Marion L. Folsom; "What's on the Worker's Mind," by Whiting Williams; "Television, Its Fundamental Physical and Psychological Principles," by J. O. Perrine; "The Press and Public Opinion," by Dr. H. C. Parmelee; "Proposals for Federal and State Legislation," by James A. Emery; and "A Ten-Year Plan for America," by Matthew Woll. Discussions are being held on each topic, and various subjects will also be discussed at sectional conferences during two noon periods. Those for today include, "Overcoming Seasonal Fluctuations," led by Glen Gardiner; "Unemployment Relief Measures," led by Albert M. Jones; and "Railroad Problems," led by Roy V. Wright. Tomorrow noon's include: "Trend of Hours and Leisure Time," led by E. O. Otis, Jr.; "Vocational Tests and Training," led by Paul Viets; and "Pensions," led by W. W. Stewart.

A special conference for smaller industries, for which programs were given on pages 260h (Aug. 6) and 192h (July 23) of *American Machinist*, was held from Aug. 10-15. Tentative plans for the formation of a permanent organization to discuss the problems of the small industry was the principal result, but a great future work for this type of organization was confidently expected. In fact, the attention and enthusiasm of the delegates was of a much higher order than that usually exhibited at such gatherings, and augurs well for the future. Other subjects discussed included the importance and relative position of the smaller plant in our business structure, and the need for them, especially at this time, to stand together. Disadvantages of the large company's complicated structure and difficulties of the present Anti-Trust Laws were also discussed, as was the comparative bargaining power of the small unit, the group of small units and the large company.

Beginning Aug. 15, three groups held simultaneous meetings, those on Industrial Supervision, Plant Training, and Personnel Principles and Methods. Programs for these meetings were summarized in *American Machinist* page 260h (Aug. 6). Meetings of the group continued for ten days, with a number of industrial leaders taking part. Problems and methods in each of the three divisions were explained, analyzed and discussed.

Steel Fabricating Group Accepts Practice Rules

Trade practice conference rates adopted by the reinforcing steel fabricating and distributing industry at a conference held in Asheville, N. C., in April, 1929, have been accepted by the industry following a partial rewording by the Federal Trade Commission. The Commission also declined to approve or accept six rules formerly accepted as expressions of the industry.

Labor Turnover

The Bureau of Labor Statistics, United States Dept. of Labor, shows for industry as a whole a July accession rate of 3.02 per 100 persons on the payroll. The total separation rate was 4.67 per 100, 1.10 of which were classified under quit, 0.25 under discharge, and 3.32 under layoff. Iron and steel industries had the lowest accession rate, 2.32, with a separation rate of 2.8 divided into .94 quit, 0.12 discharge and 1.7 for layoff. Foundry and machine shops had the lowest quit rate, 0.68, the discharge rate being 0.20 and the layoff rate, 4.71, to make a total separation rate of 5.59. The accession rate for foundries and machine shops was 2.63. The automobile separation rate was 8.21 per 100, 6.89 of which were layoffs, indicating the July vacation shutdown. The discharge rate was .33 and the quit rate, .99. The accession rate, however, was 4.12.

Exports Last Month Lowest in Seven Years

Dropping to a new low level for recent years, the value of United States merchandise exports for July totaled $183,000,000, or less than in any month since September, 1924, when they were $156,100,000, according to statistics issued recently by the Department of Commerce. With imports during July of $175,000,000, the combined value of American foreign trade in that month amounted to $358,000,000. This represented a decline of $2,863,000 from the June total, but was $129,319,000 less than the combined value of imports and exports for the corresponding month last year and was $379,841,000 less than that for July, 1929.

Propeller-type runner with adjustable blades for variable-head operation, first in this country to follow European practice, and guide vanes of one of the four 15,000-kw. water wheels for the Rock Island hydroelectric plant on the Columbia River, Washington

Eight Boston Plants to Be Visited During Metal Congress

Eight plants in the Metropolitan Boston area will be visited by the engineers attending the National Metal Congress and Exposition there the week of Sept. 21. Watertown arsenal will be visited the morning of Sept. 22. The following day officials of the Fore River plant, Bethlehem Shipbuilding Corp. will escort groups through the repair docks, forge plant and other interesting departments. An optional trip is to the plants of the Boston Gear Works and Pneumatic Scale Co. On Sept. 24, the River works of General Electric Co. will be open to inspection. An alternative trip is to Naumkeag Steam Cotton Co., Salem, Mass. The United Shoe Machinery Co. or the Trimont Mfg. Co. may be visited on Sept. 25.

The Society of Automotive Engineers has arranged to meet in Boston the week of Sept. 21 as part of the program. R. S. BURNETT, manager of standards of the S.A.E., has arranged a session dealing with problems of the automobile industry from the standpoints of metallurgy, production and cost. This session will be held Wednesday morning, Sept. 23 at the Hotel Statler. Members of the S.A.E. will also attend the sheet steel and stainless alloys sessions of the American Society for Steel Treating on Tuesday and Friday mornings respectively. Registration for the S.A.E. will be at the Hotel Statler where the A.S.M.E. and A.I.M.E., will also register. A.S.S.T. members will register at Commonwealth Pier where the exposition will be held, and Welding Society members will register at the Copley-Plaza Hotel. All technical sessions will be held at the Hotel Statler except those of the A.W.S. which will be at the Copley-Plaza.

Hoover Appoints Gifford To Lead Idle Relief

As a major step toward formulating a plan for meeting the unemployment crisis during the coming Winter, President Hoover has announced the appointment of Walter S. Gifford of New York, president of the American Telephone & Telegraph Co., to set up an organization to mobilize the facilities of the nation for meeting the situation.

The President, in his letter of appointment, told Mr. Gifford to "use your own judgment" as to the type of organization to be set up and the methods of work it should follow, and pledged him the "whole force of the administration" in carrying out the task. He foresaw much need this winter.

The task of the organization, the President said, shall be "to cooperate with the public authorities and reinforce the national, state and local agencies which will have responsibility for the relief activities."

Mr. Gifford issued an appeal to the business and welfare agencies of the country to create definite organizations to cope with the relief problem where such do not now exist. He also urged that, so far as practicable, appeals for relief funds should be made simultaneously throughout the country. He emphasized that he was making no suggestion for a national fund. He announced that he would summon representatives of welfare organizations at an early date to advance the planning of a relief program.

Assurance of full cooperation of the manufacturers of the country was given to President Hoover by JOHN E. EDGERTON, president of the National Association of Manufacturers.

Russia to Establish 100 Machinery Works at a Cost of $4,000,000,000

BY OUR BERLIN CORRESPONDENT

The Russian Government intends to begin its second 5-Year Plan of Industrialization in 1932. For this purpose the Supreme Economic Council is at present electing committees to work out suitable proposals; several projects having already been set up.

All measures and proportions common to Soviet Russia are vastly surpassed by the new projects. A few statements from these projects characterize the whole Russian working tendency:

In the industrial territory of Ural-Kusnezk 100 machinery works, with a yearly output of $6,000,000,000, are to be erected at a total first cost of $3,500,000,000 to $4,000,000,000. For a better understanding of these figures let it be stated that in 1925 the value of the total machinery production of all countries of the world amounted only to $5,200,000,000, if based on the prices effective at that time. The pig-iron output is to be 66 million tons in 1937, whereas the output during the present year is estimated at only 9 million tons. Similarly, the coal output is to be raised to about 550 million tons in 1937, as against an estimation of only 92 million tons for 1931. The corresponding figures for the naphtha output are 140 to 165 million tons, as compared to 28 million tons for the present year.

To a great extent the 100 machinery works projected are to manufacture machine tools, particularly less complicated machine tools such as multi-cutter lathes and horizontal boring and turning mills, automatics, punch-presses and dies, lapping and honing machines. These are supposed chiefly to cover the requirements of the repair shops and the governmental, or collective agricultural, shops; especially, however, they are intended to serve for equipment of the numerous apprentice schools, which are being established. As far as all this is concerned, complete agreement exists with the Soviet authorities as to the enumeration of the working program. However, this does not apply to the manufacture of machine tools for the remaining industrial branches.

In the first place there is a divergence of opinion as to whether the Russian machine tool industry should take up the manufacture of complicated machine tools, or whether here, too, simpler types are to be preferred. From the viewpoint of the theoretically better trained American and German engineers it is decidedly better for the Russian factories first to design simpler machine tools only; for, as is known, very considerable manufacturing difficulties are encountered when making complicated machine tools and, in addition there is also the greater wear and the more frequent repairs to be taken into account, which latter—at least for the time being—cannot be made properly in Russia owing to the lack of a sufficient number of trained workmen. Extreme complaint is made in the technical press about the bad equipment of Russian machine tool works already existent; and, more still, about the careless handling of the expensive machine tools bought in foreign countries; facts, which in the new 5-Year Plan are also to be abolished by appropriate regulations and training courses for the workmen. Furthermore, in the new plan provisions are made for striving at independence from foreign countries in the manufacture of high-quality cast steel, ball-bearings, and the like. Therefore, the manufacture of these parts is also to be specially pressed. Still another important item is the intention to follow up more closely the making of dies and fixtures. At present the Russian tool manufacturing works are not nearly in a position to supply the total tool requirements of the Soviet Union. The Russian factories are therefore obliged to make their tools for themselves; that is, both special as well as standard. These tools usually are of inferior quality, as in most cases they are made without adequate experience. By the way, the equipment of the tool-shops is very unsatisfactory also, and further there is

a great want of well-trained labor. At present, plans for only two more new tool manufacturing works have been completed, which will not by far be able to cover the requirements of the Soviet Union. The establishment of tool making works, too, is therefore particularly taken care of in the new 5-Year Plan. In this connection also a great number of foreign engineers and trained workmen are to be engaged for the USSR.

Of course, it is still a long way to the completion of all Russian industrialization plans already existing and newly drawn up, and until then the other countries are sure still to receive large orders from Russia. But here too, the government, or rather its various authorities, have taken care that prospects do not become too bright. The attitude of the Russian government when buying foreign machinery is well characterized by a publication of the former head of the department for economic studies of the Russian commercial representation in Berlin, R. Anders, who is now active in an executive committee in Moscow; and which appeared in the official paper of the supreme economic council of the "SA INDUSTRIALISAZIJU" on June 3rd with the heading: "The world crisis and Russian machinery imports." This publication supplies some interesting information about the leading ideas of the foremost Russian authorities; and at the same time terms of reference are drawn up for the future conduct of Russian authorities when purchasing machines. Mr. Anders declares that the world crisis has not yet taken hold of the machinery industry in full force. Rather, its effects are still to become noticeable. The importance of exports for the machinery production of capitalistic countries is becoming more and more apparent; however, there are signs that the "international exports in machinery" have entered a critical stage. Under these circumstances the Soviet market is the only one offering the international machinery exports any possibilities for expansion. Previous price reductions are to have been wholly insufficient and in no proportion whatever to the "depth of the crisis." Mr. Anders concludes his explanations with the following: "Our tactical position regarding machinery imports in 1931 thus is more favorable than ever. It is our business to mark with the stamp of this crisis the international machinery prices not yet reduced to the utmost."

International Price Agreement

Much of what Mr. Anders says is perhaps only to be regarded as propaganda for the communistic idea. Still his challenge for further price reductions should at last put forth the question whether it were practical to stop prices of Russian purchases from declining below certain limits, to be set by *international agreement* arranged by the syndicates or associations of machinery manufacturers. Today this can still be done; in a few years' time there will be no chance further to supply Russia with machinery anyhow, considering its efforts for emancipation.

International Standardization

OLIVER P. VAN STEEWEN

Standardization is perhaps best defined as the outcome of a long series of individual minor, though often tedious, investigations. Thus, even in national standardization work, it is not a simple matter to characterize results. To an even greater extent, this is true of international negotiations; for here one is not concerned with the establishment of international standards, but with an assimilation of national standards already existent in different countries.

It was to serve this purpose that the series of meetings of the International Federation of the National Standardizing Associations took place in Copenhagen, Denmark, recently. The committees in attendance were those on aircraft matters, agricultural machinery, rivets, threads, screws, drawings, ball bearings and fit tolerances. The importance of this international meeting becomes at once apparent when it is stated that sixteen countries with a total of eighty representatives took part in it, including Austria, Belgium, Czecho-Slavakia, Denmark, England, France, Germany, Holland, Italy, Japan, Norway, Poland, Russia, Sweden, Switzerland and the United States.

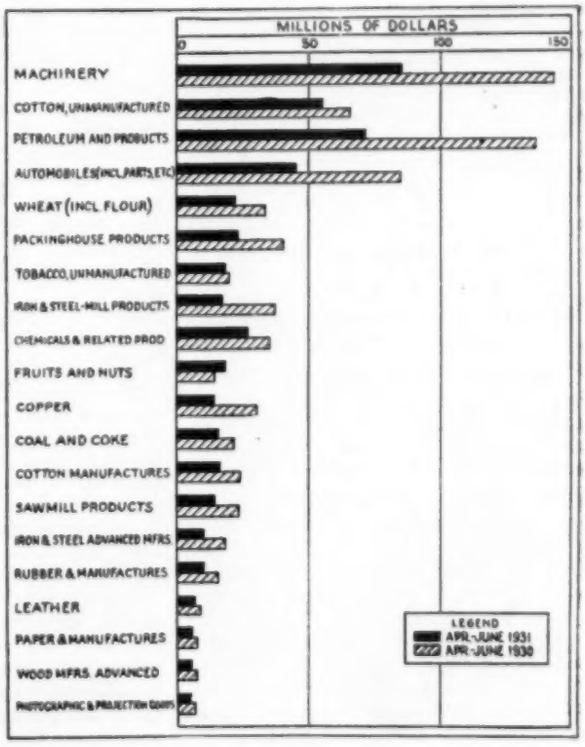
First place in results should be awarded to the meetings of the Twentieth Committee for Aircraft Matters. Further noteworthy work was done in connection with fit tolerances. Whereas three years ago, it seemed well nigh impossible to come to an agreement in this matter in the second meeting of the committee the acceptance of the proposals elaborated by the sub-committee entrusted could be ascertained on behalf of fully fifteen countries. This may be regarded as a proof of the possibility of successful international cooperation and, not in the least measure, it is to be accounted for by the fact that the experts of the various countries forming the sub-committee, and acting solely as such, have tried to come to mutual agreement free of national ambitions, considering only technical requirements. Further, it should be pointed out that, concerning ball bearings, international agreement has been attained as to all the chief dimensions of both radial and thrust bearings. The same applies to the tolerances, the measurement of tolerances and the running accuracy of bearings.

International agreement on rivet dimensions was restrained by the wide variation of regulations set up by classifying organizations. Therefore, the secretary's office of the committee is to get in touch with these organizations and thus try to establish a basis for international standardization.

The main result regarding screws was a general assent that the height of nuts, both machined and rough, is to be made 0.8 times the thread diameter.

The international unification of drawing directions is of utmost importance, considering modern international business intercourse. However, in this case, its attainment is especially difficult, because drawing standards already exist in the various countries and, moreover, the items involved are not so much of a technical nature, but rather of a habitual one. The work to be done in connection with international standardization of drawings has been passed on to sub-committees, in order that these should try to find a possible solution for uniting the existing national standards.

Regarding threads, principally an acknowledgment of previous settlements was sought for. International agreement is held for metric threads from 6 to 80 mm., and also for the preferred metric fine threads. Furthermore, the probational use of German standards for thread tolerances was recommended to other countries.



U. S. exports of leading commodities, second quarters of 1931 and 1930

BUSINESS ITEMS

The Worthington Pump & Machinery Corp., Harrison, N. J., has acquired the manufacturing and marketing facilities of Metalweld, Inc., Philadelphia, Pa., builder of a complete line of portable compressor units. Last year it took over the manufacture and sale of Gilman rock drills and accessories. This, together with the added line of portable and semi-portable compressors and other tools, will enable Worthington to supply all air equipment requirements of contractors, railroads, utilities and industrial users. The portable compressors will be manufactured at the Harrison works of Worthington, and the engineering, manufacturing and sales personnel of the Metalweld organization also will be located there.

The Hooven, Owens, Rentschler Co., Hamilton, Ohio, has been awarded a $1,500,000 contract by the city of Vernon, Calif., for five Diesel engine electric generating units of 6,000-kw. each. The first of the units is to be delivered to the city within eight months and the remaining units one each month thereafter. According to news reports, these are not only the largest Diesel engines being constructed in this country but the number of them makes the plant the largest American Diesel plant.

The Superior Tool & Engineering Co., 1093 71st Ave., Oakland, Calif., is engaged in the manufacture of automatic machinery, tools, dies, jigs, and fixtures. It plans also to do experimental research work. E. W. Olin and W. D. Peel are the proprietors.

The Monarch Machinery Co., Philadelphia, Pa., has been merged with L. F. Seyfert's Sons, Inc., Philadelphia. The machine tool department will be under the personal supervision of Edwin W. Stegman.

The Winsted (Conn.) Insulated Wire Co., was sold at auction Aug. 17 to Charles J. Royal, secretary of the Hudson Wire Co., Ossining, N. Y., for $15,000. The appraised value of the plant was $10,400 and the wire enameling machinery, other fixtures and stock inventoried at $26,270. The sale is subject to approval by the Superior Court Judge. Mr. Royal declares it is possible the Hudson company will operate or organize a subsidiary company.

The Union Twist Drill Co., Butterfield Division, Derby Line, Vt., has completed arrangements with the Wesson Co., 1050 Mt. Elliott Ave., Detroit, to represent Union throughout Michigan.

Negotiations are in progress which are expected to result in acquisition of a controlling interest in the National Erie Co., manufacturer of steel castings of all kinds and various types of gears, by the Bucyrus-Erie Co., manufacturer of steam shovels, excavating machinery and contractors' equipment. During normal times a major portion of the output of the National-Erie Co. is utilized by the Bucyrus-Erie local plant.

The Synthane Corp., Oaks, Pa., has appointed two additional distributors for the company's laminated bakelite sheets, rods, tubes and stabilized gear material. They are: Industrial Products Sales Corp., St. Louis, Mo., J. E. Jury, general manager; and H. Douglas Stier, 101 Marietta St., Atlanta, Ga.

The Babcock & Wilcox Co., 85 Liberty St., New York, N. Y., has appointed Fred Sprinkman & Sons, 116 So. Second St., Milwaukee, Wis., distributor of B. & W. No. 80 refractory mortars and plastics for that district.

The Alex Martin Mfg. Co., Ltd., has leased premises at 201 E. 11th St., Oakland, Calif., to manufacture automotive accessories. P. B. McCracken is manager.

The Union Twist Drill Co., Butterfield Division, Derby Line, Vt., is using that address instead of the former address of 406 E. Woodbridge, Detroit.

The R. L. Balzer Machinery Co., Portland, Ore., will represent and direct the sales and service of the Marion Shovel Co. in the Northwest territory.

PERSONALS

F. C. Butman, formerly with the Dispatch Oven Co., Minneapolis, Minn., but lately on leave of absence as efficiency engineer for Roneo, Ltd., Romford, England, has been made district manager of western New York territory for Dispatch. E. B. Wolf has joined the Detroit sales office of the company.

Don M. Compton, and Sheldon Clark, vice-president of the Sinclair Oil Co., were elected Aug. 17 to the board of directors of the Grigsby-Grunow Co., Chicago. Mr. Compton has been executive vice-president and treasurer for several years.

William H. Crosby, formerly president of the Crosby Co., sheet metal stampings, Buffalo, has been elected chairman. Henry W. Crosby, formerly secretary, has been elected president; Edward S. Gram, vice-president; John M. Smith, treasurer; Howard W. Kurtz, formerly assistant engineer, now is assistant treasurer; Fred C. Burkhardt, chief engineer, now also is secretary; Charles L. Sager is assistant secretary, and Charles J. Pankow is superintendent.

O. L. Egtvedt, vice-president of Boeing Airplane Co., Seattle, Wash., has assumed direct management of the company and G. W. Carr has been appointed plant manager. Mr. Egtvedt entered the service of the Boeing Airplane Co. in 1917 as design engineer, later holding the positions of chief engineer and secretary, and was elected to the vice-presidency in 1926. As assistant to the president, Mr. Carr has acted in the capacity of plant manager for the past two and one-half years. He entered the engineering department of the Boeing organization in 1924, became purchasing agent in 1926 and assistant to the president in 1928.

William J. Gibney, vice-president of Bingham & Taylor, Buffalo, N. Y., has resigned to become assistant to the president of the Strong Steel Foundry Co., also of Buffalo.

Henry H. Heimann has been elected president of the National Association of Credit Men, to succeed Dr. Stephen I. Miller after Sept. 1. He is vice-president of the Kawneer Co., Niles, Mich., and a director in several other organizations.

Edward C. Holmes, a director for ten years of Cobb & Drew, Inc., Plymouth, Mass., has been elected president to succeed Charles A. Bumpus, who died recently. Mr. Holmes' father was treasurer of the company for years.

Frank W. Jones has been elected vice-president and general manager of the Hanover (Pa.) Wire Cloth Co.

C. A. Macfie has been appointed assistant sales manager of Revere Copper & Brass Inc., 230 Park Ave., New York City, with headquarters in the General Sales Dept. He has been in the copper and brass business since 1912, starting with the U. T. Hungerford Brass & Copper Co.

Edward L. Ryerson, Jr., president of Joseph T. Ryerson & Son, Inc., Chicago, has been appointed a member of the Chicago Community Trust, succeeding the late Bernard A. Eckhart.

John J. Stanton, merchandise manager of the Northwest District, Westinghouse Electric & Mfg. Co., has been appointed Milwaukee manager. In his new capacity, he has charge of the State of Wisconsin and the upper Peninsula of Michigan.

Arthur B. Stedman has been elected to the board of directors of the Billings & Spencer Co., Hartford, Conn., to fill the vacancy caused by the resignation of Arthur D. Deute.

Alex Taylor, former vice-president and secretary of the Lake Superior Corp., who resigned and left for England a short time ago, will return to Canada immediately to assume the presidency of Algoma Consolidated Corporation, the company which takes over the Lake Superior undertakings as a result of the recent reorganization. Mr. Taylor succeeds Frank Common as head of the new holding company. Mr. Common resigns after completing the reorganization, and will devote his time to his legal business.

Frank J. Tone, president of the Carborundum Co., Niagara Falls, N. Y., has been chosen as first winner of the Jacob F. Schoellkopf Gold Medal of the Western New York Section, American Chemical Society, for achievement declared to constitute a major advance in science and to embody the spirit of research in industry. Outstanding contributions of Mr. Tone, as cited by the Jury of Award, include his work, with the late F. A. J. Fitzgerald, on the properties and commercial applications of silicon carbide; the production of pure metallic silicon, and the industrial application of electrochemistry.

ONE and a HALF
Robert Hamilton, 4 ft. 11 in. tall, 114 lb., and Carl Lindgren, 6 ft. 6 in. tall, 200 lb., machinists, Pratt & Whitney Aircraft Co.

I. EDMUND WAECHTER has joined the American Hammered Piston Ring Co., a subsidiary of the Bartlett-Hayward Co., Baltimore, Md.

J. S. WILSON has been made superintendent of shops at Detroit for the Michigan Central Railroad, to succeed J. BOWEN.

OBITUARIES

CARLETON M. BOWER, 51, a vice-president of the Southern Wheel Co., died Aug. 10 in New York City, after an illness of several months. He was formerly vice-president of the National Car Wheel Co., later absorbed by the Southern Wheel Co.

HOWARD L. BROWNING, 74, pioneer in the electrical field, who sold and installed the first incandescent plant in the United States, died Aug. 11 in Pittsburgh after a long illness. Mr. Browning became associated with the Edison Mfg. Co. early in its existence and was made New York agent. Later, he formed the Browning Electric Mfg. Co., in which he sold his interest after a few years to join the General Electric Co., Fort Wayne, Ind. He was connected with the Ochiltree Electric Co. at the time of his death.

EDWARD H. COLGAN, 63, owner of the Little Rock (Ark.) Boiler & Iron Works, died recently. He founded the company in 1905.

GEORGE S. GARRITT, 67, Pacific Coast manager of sales for the Columbia Steel Co. for many years, died in San Francisco Aug. 20 after an operation.

WILLIAM S. HALL, 87, president of the Eagle Iron Works Co., 829 So. Fifth St., Minneapolis, Minn., prominent in the Minneapolis iron and machinery trade for more than half a century, died at his home in that city recently, after an illness of three years.

E. D. JACKSON, sales manager of the Syntron Co., Pittsburgh, maker of electric hammers and arc-welding machines, died recently.

CHARLES H. LEINERT, 63, president of the Leinert Valve Co., Chicago, died recently there. He founded the company about seven years ago.

GEORGE A. NEWMAN, secretary of the Syracuse (N. Y.) Chilled Plow Co., died recently.

CHARLES PFAU, 73, owner of the Pfau Manufacturing Co., Cincinnati, Ohio, and inventor of a number of plumbing and general appliances, died there Aug. 20.

JOHN A. REID, 73, vice-president of the Singer Sewing Machine Co. and Singer Mfg. Co., died at Rye, N. Y., Aug. 18. Mr. Reid's career with the Singer Sewing Machine Co. lasted fifty-four years during which he was instrumental in developing many of the power machines, some of them highly specialized, which are used in the garment industry. He retired in 1928.

CHARLES W. SPONSEL, 70 inventor of the Sponsel rapid-fire gun and a mechanical engineer of note, died Aug. 17, at Hartford, Conn. He was formerly for five years superintendent of the General Electric Co., and had many important inventions to his credit.

CLIFFORD H. TERRY, 58, purchasing agent of the American Telephone & Telegraph Co., died of heart disease Aug. 12, in East Orange, N. J.

THOMAS MUIR THOMSON, 50, retired mechanical engineer of Port Joli, Que., died Aug. 19 there.

OTIS L. WILLIAMS, 66, former officer of the Westinghouse Machine Co., and member of the firm of Westinghouse, Church, Kerr & Co., New York, N. Y., died after a long illness Aug. 14.

WILLIAM H. WILSON, purchasing agent of the Hayes Wheel Co.'s Merriton, Ont., plant for the last ten years, died there following a short illness.

HENRY W. ZIMMERMAN, 72, founder and president of the Atlas Engineering Co., Milwaukee and Clintonville, Wis., died recently.

MEETINGS

SOCIETY OF AUTOMOTIVE ENGINEERS
National aeronautic meeting, Sept. 1-3, Hotel Statler, Cleveland. John A. C. Warner, secretary, 29 W. 39th St., New York, N. Y.

INTERNATIONAL ASSOCIATION FOR THE TESTING OF MATERIALS
First Congress, Sept. 6-12, Buildings of the Swiss Federal Polytechnicum, Zurich, Switzerland. C. L. Warwick, secretary-treasurer, A.S.T.M., 1315 Spruce St., Philadelphia, Pa., or W. H. Fulweiler, A.S.T.M. representative on the Permanent Committee, Chemical Engineer of the United Gas Improvement Co., Philadelphia.

STEEL FOUNDERS' SOCIETY OF AMERICA, INC.
First fall meeting, Chicago, Sept. 17, Granville P. Rogers, managing director, 932 Graybar Bldg., New York, N. Y.

NATIONAL METAL CONGRESS AND EXPOSITION
Exposition on Commonwealth Pier and Congress sessions at Hotel Statler, Boston, Mass., week of Sept. 21. Meetings of A.W.S., A.S.M.E., A.I.M.E., and American Society for Steel Treating in connection. Information from W. H. Eisenmann, secretary A.S.S.T., 7016 Euclid Ave., Cleveland, Ohio.

SOCIETY OF AUTOMOTIVE ENGINEERS
National production meeting, Detroit, Mich., Oct. 7-8. John A. C. Warner, secretary, 29 W. 39th St., New York.

SOCIETY OF INDUSTRIAL ENGINEERS
Annual meeting, Pittsburgh, Pa., Oct. 14-16. George C. Dent, secretary, 205 W. Wacker Drive, Chicago, Ill.

NATIONAL SAFETY COUNCIL
Twentieth Annual Safety Congress, Chicago, Ill., Oct. 12-16. W. H. Cameron, secretary, 20 North Wacker Drive, Chicago.

GRAY IRON INSTITUTE
Fourth annual convention, West Baden Springs Hotel, West Baden Springs, Ind., Oct. 15-16. J. Arthur Tuscany, secretary, Terminal Tower Bldg., Cleveland.

AMERICAN MANAGEMENT ASSOCIATION
Industrial marketing conference, Hotel Statler, Cleveland, Ohio, Oct. 21-23. Headquarters, 20 Vesey St., New York, N. Y.

STEEL FOUNDERS' SOCIETY OF AMERICA, INC.
New York meeting, Oct. 22. Granville P. Rogers, managing director, 932 Graybar Bldg., New York, N. Y.

SOCIETY OF AUTOMOTIVE ENGINEERS
National transportation meeting, Washington, D. C., Oct. 27-29. John A. C. Warner, secretary, 29 W. 39th St., New York,, N. Y.

AMERICAN MANAGEMENT ASSOCIATION
Annual convention, New York, N. Y., Nov. 17-19, devoted to the general theme of Coordinated Industrial Planning. Headquarters, 20 Vesey St., New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS
Annual meeting, Engineering Societies Bldg., New York, N. Y., Nov. 30-Dec. 5. Calvin W. Rice, secretary, 29 West 39th St., New York, N. Y.

FIRST NATIONAL EXPOSITION OF MECHANICAL HANDLING EQUIPMENT
Grand Central Palace, New York, N. Y., Nov. 30-Dec. 5. Charles F. Roth, secretary, Grand Central Palace, New York, N. Y.

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Opportunities for Future Business

Calif., Alameda—L. Larson, Construction Quartermaster, 33 Pacific Ave., is having plans prepared for a group of air depot buildings including 100 x 180 ft. adminstration building, 334 x 480 ft. depot supply building, 200 x 440 ft. hangar, heating plant, pumping station, radio station, etc. Estimated cost $743,000. Ultimate total cost $2,700,000.

Calif., Alameda — San Francisco Bay Airdrome, 2135 Webster St., awarded contract for the construction of a shop.

Calif., Anaheim — Schofield Automotive Engineering Inc., plans the construction of a 2 story factory. Estimated cost $40,000. A. Curlett, Union Bldg., Los Angeles, Archt.

Calif., Keddie—Western Pacific R.R., Mills Bldg., San Francisco, awarded contract for the construction of a round house, etc. Estimated cost $25,000. J. W. Williams, San Francisco, Ch. Engr.

Calif., Stockton—Fraser Furnace Co., 445 South Joaquin St., awarded contract for a 1 story, 110 x 150 ft. factory on Scotts Ave. Estimated cost $60,000 including equipment.

Conn., Hartford—International Harvester Co., North Main St., is receiving bids for the construction of a 1 story, 80 x 260 ft. sales and service building on North Main St. Estimated cost $75,000. Private plans.

Ga., Atlanta—American Airways, Inc., 1404 Main St., Dallas, Tex., c/o C. R. Smith, Candler Field, Atlanta, plans the construction of a hangar including shops, etc. Estimated cost $75,000. B. A. Slater, c/o owner, engr.

Idaho, Priest River—Pacific States Pulp & Paper Co., c/o A. T. Peterson, V. Pres., plans the construction of a 100 tons sulphate pulp mill. Estimated cost $2,500,000.

Ind., Anderson — Anderson Battery Co., awarded contract for the construction of a factory on Center Ave. Estimated cost $40,000.

Ia., Hamlin—Iowa State Highway Commission, L. M. Martin, Dist. Engr., Council Bluffs, will receive bids until Sept. 1 for the construction of a maintenance garage, here.

Mass., Medford—Boston Elevated Railway Co., 31 St. James Ave., Boston, will soon award contract for foundation of a 1 story, 65 x 155 ft. bus garage at Salem and Felsway St. W., here. Estimated cost $50,000. A. J. Blackburn, 31 St. James Ave., Boston, Archt.

Mass., Worcester—Sewer Dept., City Hall, received lowest bid for the construction of a 2 story workshop and storehouse at East Worcester St. yard, from A. J. Gendron, 114 Coburn Ave. $112,395. R. C. Gorrani, 175 Green St., Archt. Noted Aug. 13.

Mich., Mount Clemons — Constructing Quartermaster, awarded contract for the construction of a machine shop, assembly building, warehouse, and four hangars at Selfridge Field. Noted June 25.

Minn., Minneapolis—East Side Tire & Supply Co., E. J. Loring, Secy., 423 Central Ave., awarded contract for a 1 story, 30 x 50 and 28 x 32 ft. repair and service station.

Minn., Minneapolis—F. E. Lampson, Meadville via Excelsior, Lake Minnetonka, is receiving bids for the construction of a 1 story, 90 x 116 ft. repair and service garage at 29th St. and Hennepin Ave., here. Estimated cost $25,000. P. Crosier, 1016 Phoenix Bldg., Archt.

Minn., Minneapolis—Marquette Mfg. Co., 401 Johnson St. N. E., manufacturers of automotive equipment, has work under way on the construction of a 1 story, 32 x 40 ft. addition to factory. Work being done by day labor.

Mo., Excelsior Springs—U. S. Veterans' Bureau, Washington, D. C., will soon award contract for the construction of sixteen garage buildings at U. S. Veterans' Hospital here.

Mo., Kansas City—City, is having revised plans prepared for the construction of a group of buildings to include 1 story, 120 x 400 ft. hangar, 50 x 400 ft. lean-to, 40 x 120 ft. testing building and 40 x 170 ft. office at Municipal airport.. Estimated cost $250,000. A. H. Gentry, Fairfax Bldg., Archt. Transcontinental & Western Air, Inc., lessee.

Neb., Lincoln—City, T. H. Berg, Clk., will soon award contract for a 2 story garage and city gas station at 19th and Q Sts. Estimated cost $25,000. Miller & Craig, 126 South 11th St., Archts.

N. J., Bordentown—Dept. of Institutions & Agencies, W. J. Ellis, Comr., State Office Bldg., Trenton, is having revised plans prepared for the construction of various buildings at Industrial school for Colored youth here. Estimated cost $400,000. Noted Aug. 20.

N. J., Newark—Board of Commissioners, City Hall, will soon award contract for a 2 story, 130 x 190 ft. addition to automobile service station, garage and repair shop on Victoria St. Estimated cost $300,000. Private plans.

N. J., Nutley—George A. La Monte & Sons, 299 Kingsland Road, awarded contract for the construction of a 2 and 3 story factory addition. Estimated cost $40,000.

N. J., Union City—J. G. Helmers, 147 Summit Ave., Archt., will receive bids about Sept. 15 for the construction of a 2 story garage on 14th St. for owner, c/o architect. Estimated cost $150,000. Noted Aug. 6.

N. Y., Brooklyn—Antonio Panosa, c/o A. H. Schwartz, 90 John St., New York, is having preliminary plans prepared for the construction of a 100 x 120 ft. service garage at Gravesend Ave. and Ave. O. Estimated cost $40,000. O. Goldschlag, 55 West 42nd St., New York, Archt.

N. Y., Comstock—Dept. of Correction, State Office Bldg., Albany, will receive bids until Sept. 24 for construction of a garage, blacksmith and machine shop buildings at Great Meadow Prison here.

N. Y., Jamaica—General Builders & Supply Corp., 205 East 42nd St., New York, plans the construction of a 1 story, 30 x 80 ft. garage and 1 story, 40 x 160 ft. warehouse, storage building, etc., at Liberty Ave. and 177th St. Private plans.

N. Y., New York—Dept. of Hospitals, Municipal Bldg., plans the construction of a 2 story, 122 x 174 ft. garage and storage building at Welfare Island. Estimated cost $150,000. B. R. Swartburg, 2 West 46th St., Archt. Maturity December or later.

N. Y., Long Island City—Queensboro Dairy, 35 12th Ave., Astoria, will soon receive bids for the construction of a service garage and office at 41st St. and 35th Ave. Estimated cost $40,000. B. Shutkind, 147 4th Ave., Archt.

N. Y., New York—Five Hundred Forty One West 20th St. Construction Corp., J. S. Kahn, 285 Madison Ave., will build a 3 story service garage at 537 West 20th St. Estimated cost $115,000. W. Shary, 22 East 17th St., Archt. Work will be done by separate contracts. Maturity soon. Noted Aug. 20.

N. Y., New York—Lebanon National Kosher Sausage Factory, J. Altman, Pres., 224 East 6th St., will award contract in September for the construction of a garage and storage building at West Farms Road and 173rd St. B. Shutkind, 147 4th Ave., Archt. Noted Aug. 20.

N. D., Dunsieth—San Haven Sanitarium, J. G. La Mont, Supt., will soon receive bids for a 3 story, 40 x 60 ft. garage and laundry. Estimated cost $35,000. Bugenhagen & Molander, 305 Union National Bank Annex, Minot, Archts.

O., Girard—Ohio Leather Co., will soon award contract for addition to leather plant. Estimated cost to exceed $40,000.

Okla., Tulsa—City Commissioner, E. Logan, Auditor, awarded contract for the construction of a 1 story, 60 x 72 ft. garage and fire alarm building at Central Park. Estimated cost $200,000. Noted Aug. 6.

Tenn., Memphis—Fisher Lumber Corp., Keith Spurrier, Mgr., North Second St., awarded contract for replacement of dry lumber storage sheds at large industrial plant on Wolf River. $17,000.

Tex., Jasper—Jasper Veneering & Mfg. Co., plans the construction of a crate factory to include equipment. Estimated cost $45,000. Private plans.

Wis., Eau Claire—Johnson Machine Works, 101 Menomonie St., awarded contract for a 1 story, 30 x 32 ft. addition to machine shop.

Wis., West Allis—Allis Chalmers Mfg. Co., plans the construction of a 5 story, 60 x 116 ft. addition to plant and office. Estimated cost $150,000. Maturity soon.

Ont., Hamilton—Steel Co. of Canada, Ltd., 67 Yonge St., Toronto, awarded contract for rebuilding steel furnace, also new ship hoist, revolving distributor, etc., here. Estimated cost $100,000.

Que., Grandmere—Hollands Ltd., Manchester, England, or c/o Lawson & Little, Architects' Bldg., Montreal, Que., Archts., is receiving bids for the construction of a 2 story, 90 x 100 ft. plant here. Ryan & Cambe, 1118 Phillips Pl., Montreal, Consit. Engrs.

Que., St. Lambert—J. J. Seguin Co. Ltd., plans the construction of a creosoting plant on a 65 acre site along Canadian National Railways main line to include a cylinder, eight ft. in diameter and 107 ft. long, for the pressure treatment of railroad ties, bridge timber, structural timbers, construction lumber and poles and pilings. Estimated cost $200,000. Equipment consists of Rueping tanks, mixing and measuring tanks, compressors for creation of vacuum, etc.

Equipment Wanted

Minn., Minneapolis—Handelan Mfg. Co., Handelan, Pres., 4901 39th Ave. S. (manufacturers of washed air equipment)—brake, shears and miscellaneous tinner's tools.

N. Y., New York—P. Jones, Supt. of School Supplies, Bd. of Education, Park Ave. and 59th St.—will receive bids until Aug. 31 for sheet metal, foundry and machine shop equipment, etc., for high, trade and vocational schools.

O., Bellfontaine—Bd. of Education—will receive bids until Sept. 8 for shop machinery for new high school.

Ont., Hanover—Morlock Bros.—machinery and equipment for the manufacture of upholstered furniture to replace fire loss. $60,000.

Ont., Harriston—George Neeb—woodworking machinery and equipment for the manufacture of various lines of woodenware, for recently acquired furniture factory.

Ont., London — Ford Electric Refrigerators, Ltd., W. Swarts, 277 Wortley Rd. Pres. and Gen. Mgr.—interested in prices, etc., on complete equipment for assembly plant for recently acquired building.